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INTERNATIONAL COOPERATION AND DEVELOPMENT PROSPECTS

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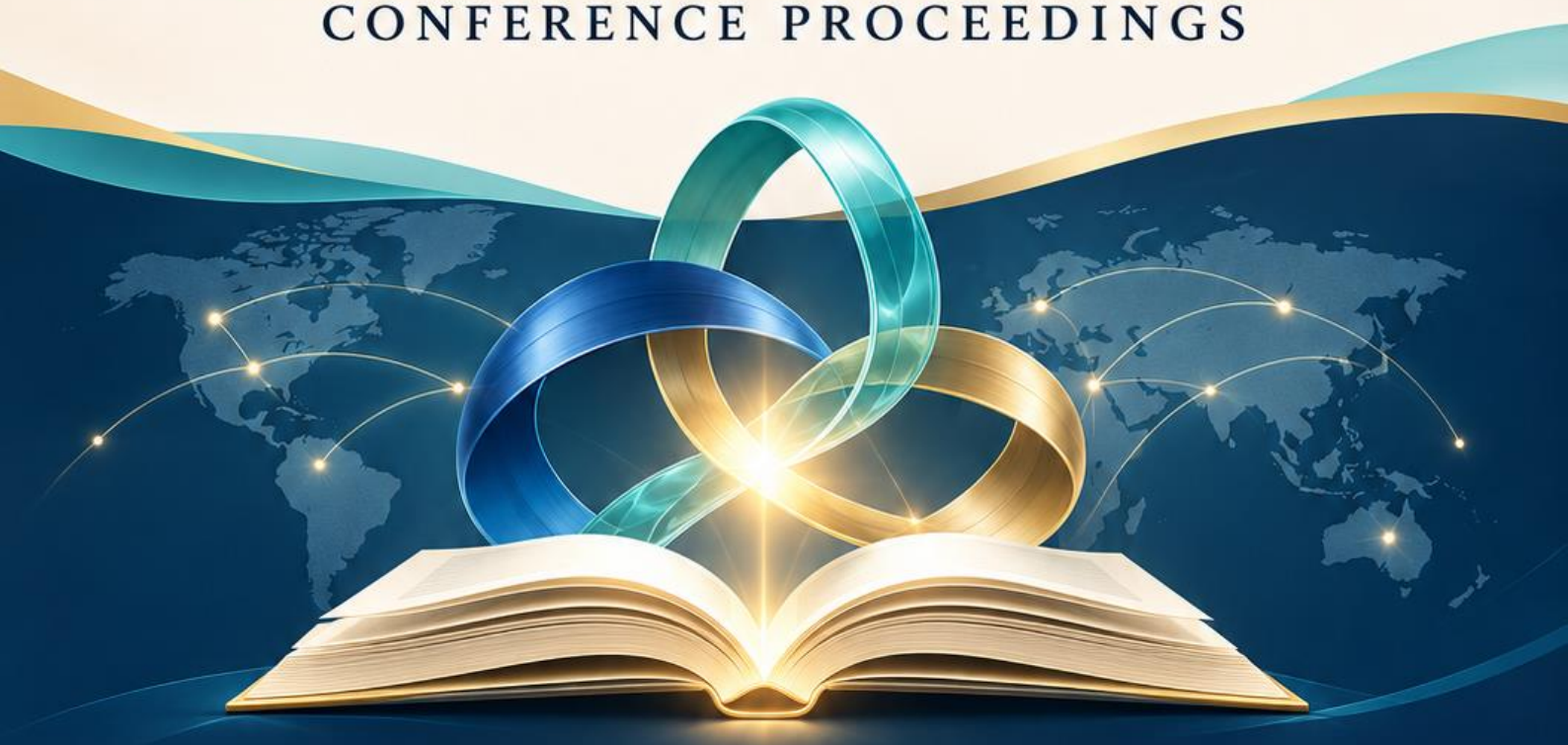

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The event aims to discuss contemporary research across various scientific fields, exchange new scientific ideas, and support scientific activities aligned with global innovative processes.

Within the conference framework, scientists, researchers, young scholars, and practicing specialists will have the opportunity to present their research findings, exchange scientific ideas, and expand international collaboration.

The main objective of this International Scientific-Practical Conference is to consolidate the results of contemporary research across various scientific fields and strengthen the integration of science and practice through advanced scientific approaches.

**The authors are responsible for the content of the articles, the information, facts, and figures presented therein.*

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1. 🎓 EDUCATION AND PSYCHOLOGY: INNOVATIVE PEDAGOGY, INCLUSIVE APPROACHES AND INTERNATIONAL EXPERIENCE.

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БИБЛИОМЕТРИЧЕСКИЙ АНАЛИЗ МОНИТОРИНГА УРОЧНОЙ И ВНЕУРОЧНОЙ ДЕЯТЕЛЬНОСТИ ПРИ ИЗУЧЕНИИ РУССКОГО ЯЗЫКА В СРЕДНИХ КЛАССАХ НА ОСНОВЕ БАЗЫ ДАННЫХ SCOPUS

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Annotatsiya. *Ushbu maqolada Scopus bazasi asosida o‘rta sinflarda (5–9-sinflar) rus tilini o‘rganishda dars va sinfdan tashqari ishlar monitoringiga oid ilmiy nashrlar bibliometrik tahlil qilindi. 2020–2025-yillarda indekslangan 214 ta hujjat Microsoft Excel va VOSviewer yordamida o‘rganildi: yillik dinamika, hujjat turlari, yetakchi davlatlar va kalit so‘zlar evolyutsiyasi. Natijalar nashrlar soni 3,87 barobar oshganini hamda an’anaviy nazoratdan formativ baholash, raqamli platformalar va sun’iy intellektga asoslangan monitoringga o‘tish tendensiyasini ko‘rsatdi.*

Kalit so‘zlar: *rus tili chet tili sifatida; o‘rta sinflar; dars va sinfdan tashqari ishlar; pedagogik monitoring; formativ baholash; bibliometrik tahlil; VOSviewer.*

Аннотация. *В статье представлен библиометрический анализ публикаций по мониторингу урочной и внеурочной деятельности при изучении русского языка в средних классах (5–9 классы) на основе базы данных Scopus. Проанализировано 214 документов за 2020–2025 годы с помощью Microsoft Excel и VOSviewer: динамика публикаций, типы документов, ведущие страны и эволюция ключевых слов. Выявлен рост публикационного потока в 3,87 раза и переход от традиционного итогового контроля к формирующему оцениванию, цифровым платформам и технологиям искусственного интеллекта.*

Ключевые слова: *русский язык как иностранный; средние классы; урочная и внеурочная деятельность; педагогический мониторинг; формирующее оценивание; библиометрический анализ; VOSviewer.*

Abstract. *This study presents a bibliometric analysis of the literature on monitoring lessons and extracurricular activities in teaching Russian in middle grades (grades 5–9), using the Scopus database. In total, 214 documents published between 2020 and 2025 were examined in Microsoft Excel and VOSviewer, with*

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attention to yearly dynamics, document types, leading countries and the evolution of keywords. Annual output grew 3.87-fold, and keyword analysis reveals a movement from conventional testing toward formative assessment, digital platforms and AI-supported monitoring.

Keywords: *Russian as a foreign language; middle grades; classroom and extracurricular activities; pedagogical monitoring; formative assessment; bibliometric analysis; VOSviewer.*

1. Введение. В 5–9 классах учащиеся, изучающие русский язык как иностранный или второй, переходят от базовых навыков к систематическому изучению языка, что делает особенно важной регулярную диагностику их успехов. Одних уроков редко бывает достаточно для формирования устойчивой коммуникативной беглости, поэтому современная методика преподавания языков сочетает уроки с языковыми кружками, читательскими клубами, олимпиадами и проектной работой [1]. Исследования формирующего оценивания показывают, что постоянная обратная связь, основанная на данных, повышает качество обучения [2], а участие в организованной внеурочной деятельности связано с более высокими академическими и психосоциальными результатами [3]. Таким образом, обе среды нуждаются в прозрачной системе мониторинга, хотя организация контроля по-прежнему описывается как одна из трудностей преподавания русского языка [4].

Традиционная практика часто опирается на эпизодические тесты по лексике и грамматике, которые лишь слабо охватывают спонтанную речь и проектную работу. С 2020 года цифровые решения в преподавании русского языка получили быстрое распространение [5, 6, 7]. В то же время соответствующие исследования рассеяны по разным журналам, а количественный обзор этой области отсутствует. Библиометрический анализ позволяет воспроизводимо картографировать такую область [8]. Поэтому цель настоящего исследования — проанализировать публикации, индексируемые в Scopus (2020–2025), о мониторинге урочной и внеурочной деятельности при обучении русскому языку в средних классах.

2. Материалы и методы. Данные были получены из Scopus — базы данных с курируемыми метаданными о рецензируемых публикациях по социальным и гуманитарным наукам [8]. Поиск охватывал 2020–2025 годы и применялся к названиям, аннотациям и ключевым словам по следующему запросу:

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TITLE-ABS-KEY (("Russian as a foreign language" OR "Russian language" OR "RFL") AND ("monitoring" OR "assessment" OR "evaluation" OR "diagnostics") AND ("classroom" OR "extracurricular" OR "secondary school" OR "middle school" OR "grades 5-9")) AND (LIMIT-TO (PUBYEAR, 2020) OR ... OR LIMIT-TO (PUBYEAR, 2025)) AND (LIMIT-TO (LANGUAGE, "English") OR LIMIT-TO (LANGUAGE, "Russian"))

После удаления дубликатов и нетематических записей осталось 214 документов. Годовой объём публикаций, среднегодовой темп роста, типы документов и продуктивность стран рассчитывались в Microsoft Excel. Карты совместной встречаемости ключевых слов и оверлейные карты были построены в VOSviewer 1.6.20 [9] с порогом не менее пяти вхождений, что дало 28 ключевых слов в четырёх кластерах. Одно из ограничений состоит в том, что Scopus не охватывает все национальные журналы, поэтому часть региональных публикаций может отсутствовать.

3. Результаты и обсуждение.

3.1. Динамика публикаций по годам. Годовой объём публикаций вырос с 15 в 2020 году до 58 в 2025 году (рис. 1), что соответствует росту в 3,87 раза и среднегодовому темпу роста 31,1 %. На первом этапе (2020–2022) было опубликовано 66 работ (30,8 %), что связано с дистанционным обучением и онлайн-мониторингом уроков [5, 6]; на втором (2023–2025) — 148 работ (69,2 %), возможно, благодаря компетентностным стандартам и таким сервисам, как LearningApps [7].

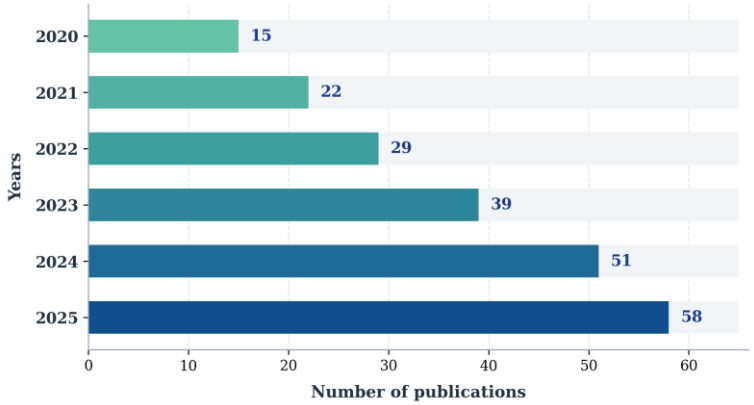

Рис. 1. Распределение публикаций по годам, 2020–2025.

3.2. Типы документов. Преобладают журнальные статьи — 76 % (163 документа), далее следуют материалы конференций (11 %, 24), обзоры (6 %, 13), главы книг (5 %, 10) и книги (2 %, 4). Это позволяет предположить, что тема распространяется преимущественно через рецензируемые журналы, тогда как малая доля обзоров указывает на нехватку работ-синтезов.

3.3. Ведущие страны. На первом месте находится Российская Федерация с 74 публикациями (34,6 %), за ней следуют Китай (42; 19,6 %), Казахстан (24;

11,2 %) и Узбекистан (19; 8,9 %) (рис. 2). Далее идут США (14), Беларусь (12) и Германия (9). Вероятно, это отражает традиции русской филологии и широкое использование русского языка в школах, что требует подтверждения с помощью контент-анализа.

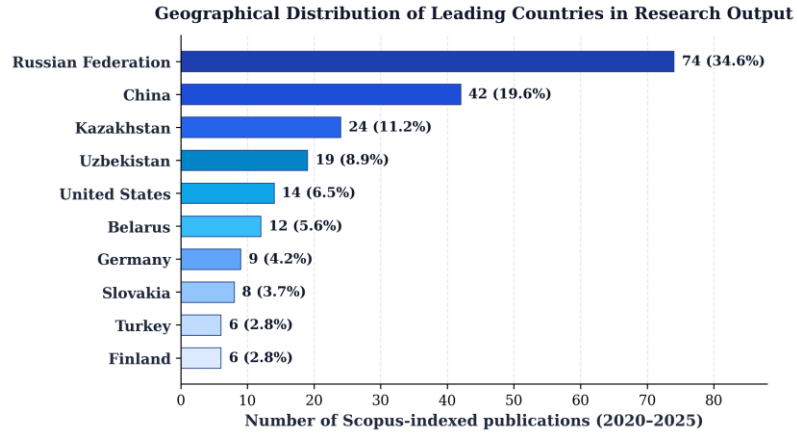

Рис. 2. Географическое распределение публикаций по странам.

3.4. Сеть совместной встречаемости ключевых слов. Сеть VOSviewer (рис. 3) содержит четыре кластера. Кластер 1 строится вокруг термина «русский язык как иностранный» (суммарная сила связей 184) и включает «средние классы», «среднюю школу» и «урочное обучение». Кластер 2 посвящён мониторингу: «образовательный мониторинг», «формирующее оценивание», «компетентностные рубрики», «карты наблюдения» и «портфолио-оценивание». Кластер 3 связывает «внеурочную деятельность» с «коммуникативной компетенцией», «языковыми кружками», «проектным обучением» и «мотивацией обучающихся». Кластер 4 содержит «цифровые образовательные платформы», «искусственный интеллект», «автоматизированную обратную связь» и «аналитику обучения». Таким образом, мониторинг уроков и внеурочной работы оказывается в разных кластерах, что указывает на потребность в интегрированных моделях мониторинга. Средние годы публикации показывают, что за ранними терминами, такими как «диагностическое тестирование» (2021,9), последовали «формирующее оценивание» (2022,8) и «компетентностные рубрики» (2023,4), что согласуется с ролью обратной связи в обучении [2], а затем — «автоматизированная обратная связь» (2024,4) и «искусственный интеллект» (2024,7), что созвучно работам о цифровых ресурсах [10]. Повышают ли такие инструменты качество мониторинга в 5–9 классах, ещё предстоит проверить эмпирически.

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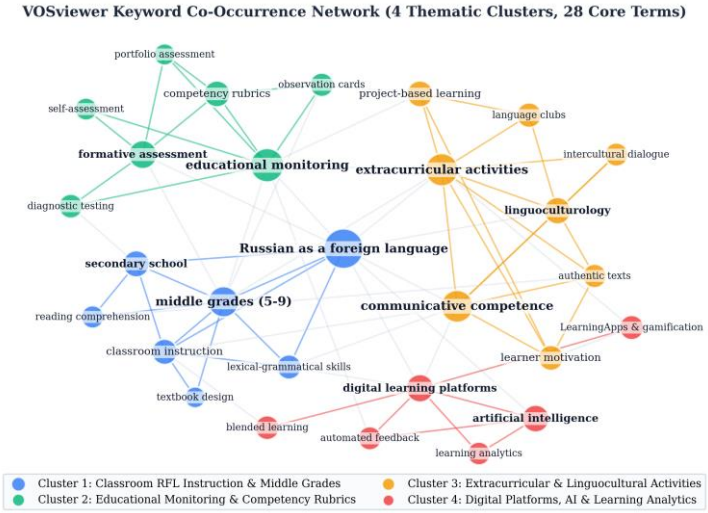

Рис. 3. Сеть совместной встречаемости ключевых слов (VOSviewer).

4. Заключение. Анализ 214 документов Scopus свидетельствует о быстром росте исследований мониторинга урочной и внеурочной деятельности при обучении русскому языку в средних классах (в 3,87 раза за 2020–2025 годы), преобладании журнальных статей (76 %) и ведущей роли Российской Федерации, Китая, Казахстана и Узбекистана. Ключевые слова отражают переход от изолированного тестирования к формирующему оцениванию, компетентностным рубрикам, цифровым платформам и искусственному интеллекту. Мониторинг уроков и внеурочной работы остаётся слабо связанным; будущие исследования должны разработать и апробировать интегрированные модели мониторинга и валидированные инструменты для 5–9 классов.

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OILAVIY MUNOSABATLARDAGI ZIDDIYATLARNING VUDUGA KELISHI HAMDA BARTARAF ETISHDA INKLYUZIV PSIXOLOGIK YONDASHUVLAR

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Annotatsiya: *Mazkur maqolada oilaviy munosabatlarda yuzaga keladigan konfliktlarning ijtimoiy-psixologik sabablari, ularning rivojlanish bosqichlari hamda oilaviy barqarorlikni ta'minlashda inklyuziv yondashuvlarning o'rni chuqur tahlil qilingan. Ayniqsa, maxsus ehtiyojli bolalar tarbiyalanayotgan oilalardagi psixologik muhit, ota-onalar o'rtasidagi ziddiyatli vaziyatlar va ularni korreksiya qilishning zamonaviy usullari yoritib berilgan.*

Kalit so'zlar: *oilaviy munosabatlar, konflikt, inklyuziv yondashuv, psixologik korreksiya, shaxslararo ziddiyatlar, maxsus ehtiyojlar.*

Аннотация: *В данной статье глубоко проанализированы социально-психологические причины конфликтов в семейных отношениях, этапы их развития и роль инклюзивных подходов в обеспечении семейной стабильности. Особое внимание уделено психологической атмосфере в семьях, воспитывающих детей с особыми потребностями, конфликтным ситуациям между родителями и современным методам их коррекции.*

Ключевые слова: *семейные отношения, конфликт, инклюзивный подход, психологическая коррекция, межличностные конфликты, особые потребности.*

Abstract: *This article deeply analyzes the socio-psychological causes of conflicts in family relationships, the stages of their development, and the role of inclusive approaches in ensuring family stability. Special attention is paid to the psychological atmosphere in families raising children with special needs, conflict situations between parents, and modern methods of their correction.*

Keywords: *family relationships, conflict, inclusive approach, psychological correction, interpersonal conflicts, special needs.*

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Kirish. Jamiyatning asosiy poydevori hisoblangan oila institutining mustahkamligi har bir davlatning ijtimoiy-siyosiy barqarorligi va farovonligini belgilovchi bosh omillardan biridir. Oila – bu nafaqat xo'jalik-maishiy birlashma, balki chuqur emotsional, axloqiy va psixologik aloqalarga asoslangan kichik ijtimoiy guruhdir. Bugungi jadal rivojlanayotgan globallashuv davrida jamiyatdagi ijtimoiy-iqtisodiy o'zgarishlar, axborot oqimining ko'payishi va hayot sur'atining tezlashuvi shaxslararo munosabatlarga ham o'z ta'sirini ko'rsatmoqda. Buning natijasida turli xil oilaviy konfliktlar va ziddiyatli holatlarning soni ortib borayotganligi kuzatilmoqda. Oilaviy ziddiyatlar (konfliktlar) er-xotinlar, ota-onalar va farzandlar o'rtasidagi qarashlar, ehtiyojlar, qadriyatlar va manfaatlarning bir-biriga mos kelmasligi yoki zid kelishi natijasida yuzaga keladi. Har qanday oilada ma'lum darajada kelishmovchiliklar uchrashi tabiiy jarayon bo'lsa-da, ularning chuqurlashib ketishi oilaning parchalanishiga, jamiyatda ajrashishlar sonining oshishiga hamda eng muhimi, farzandlar tarbiyasiga salbiy ta'sir ko'rsatishiga olib keladi. Ayniqsa, oilada rivojlanishida jismoniy yoki psixologik nuqsonlari bo'lgan (maxsus ehtiyojli) farzandlarning tarbiyalanishi ota-onalarning ruhiy holatiga jiddiy yuklama beradi. Bunday murakkab sharoitda an'anaviy psixologik yondashuvlar bilan bir qatorda zamonaviy inklyuziv yondashuvlarni tatbiq etish zarurati tug'iladi. Inklyuziv yondashuv nafaqat ta'lim tizimida, balki oilaviy va ijtimoiy munosabatlarda har bir insonning o'ziga xosligini tushunish, qabul qilish va qo'llab-quvvatlashga asoslanadi. Mazkur tadqiqot ishining dolzarbligi ham aynan shundan iborat bo'lib, u oilaviy konfliktlarning kelib chiqish sabablarini ochib berish va ularni inklyuziv psixologik metodlar yordamida bartaraf etish yo'llarini ishlab chiqishga qaratilgan. Oilaviy munosabatlardagi ziddiyatlarni o'rganish va ularning oldini olish uchun avvalo ularni keltirib chiqaruvchi sabablarni chuqur tahlil qilish lozim. Ilmiy adabiyotlarda oilaviy konfliktlar bir nechta asosiy guruhlarga bo'linadi:

- Ijtimoiy-iqtisodiy omillar: moddiy ta'minotning yetishmasligi, uy-joy muammolari.
- Psixologik-fiziologik omillar: er-xotinlarning xarakter xususiyatlari mos kelmasligi, emotsional beqarorlik.
- Muloqot madaniyatining yetishmasligi: hamda ijtimoiy-maishiy va rolli ziddiyatlar.

Yosh oilalarda bu omillar yanada yaqqol namoyon bo'ladi. Oila qurgan dastlabki yillarda moslashish (adaptatsiya) davrining murakkab kechishi ko'plab kichik tushunmovchiliklarni keltirib chiqaradi. Agar er-xotin bu bosqichdan o'zaro murosasiz o'tsa, kichik maishiy muammolar ham chuqur shaxslararo konfliktlarga aylanib ketishi mumkin. Oilaviy munosabatlarning yana bir o'ta nozik va murakkab qirrasi – bu rivojlanishida jismoniy yoki ruhiy o'ziga xosliklari bo'lgan bolalar

tarbiyalanayotgan oilalardagi muhitdir. Bunday oilalar doimiy ravishda yuqori darajadagi stress va emotsional zo'riqish sharoitida yashaydilar. Ilmiy kuzatishlar shuni ko'rsatadiki, maxsus ehtiyojli farzandning dunyoga kelishi ota-onalarda chuqur psixologik tushkunlik, aybdorlik hissi va ijtimoiy izolyatsiyani keltirib chiqaradi. Ota-onalar ko'pincha bu vaziyatni turlicha qabul qilishadi: onaning haddan tashqari o'ralashib qolishi va giperhimoya qilishi, yoki otaning vaziyatni qabul qilishda qiynalishi va oilaviy mas'uliyatdan chetlanishi. Bu holatlar o'z navbatida er-xotin o'rtasidagi hissiy aloqalarning uzilishiga va doimiy nizolarning kelib chiqishiga zamin yaratadi. Yuqorida qayd etilgan murakkab vaziyatlarda an'anaviy psixologik yordam usullari har doim ham to'liq samara bermasligi mumkin. Shu sababli, oilaviy munosabatlarga inklyuziv yondashuv asosida yondashish muhim ahamiyat kasb etadi.

Inklyuziv yondashuv oila doirasida quyidagi tamoyillarga tayanadi:

- Qabul qilish va tushunish: Oila a'zolarining har birining o'ziga xos ehtiyojlarini tan olish.
- Hamkorlik va qo'llab-quvvatlash: Mas'uliyatni teng taqsimlash va bir-biriga elka bo'lish.
- Moslashuvchanlik: Oila ichidagi qoidalarni mavjud sharoitlarga moslashtira olish qobiliyati.

Oilaviy konfliktlarni bartaraf etish va oldini olish uchun amaliy psixologiyada quyidagi korreksion usullardan foydalanish yuqori natija beradi:

1. Oilaviy psixologik maslahat (konsultatsiya): Mutaxassis yordamida er-xotinning yashirin xafagarchiliklari va muloqotdagi xatolarini ochib berish.

2. Empatik muloqot treninglari: Ota-onalarga bir-birini tinglash, o'z hissiyotlarini ochiq va tajovuzsiz bayon qilish ko'nikmalarini o'rgatish.

3. Stresni boshqarish: Emotsional zo'riqishni kamaytirish uchun relaksatsiya texnikalari va nafas mashqlarini qo'llash.

4. Inklyuziv qo'llab-quvvatlash guruhlari: Shunga o'xshash muammolarga duch kelgan oilalarning o'zaro tajriba almashishi uchun maxsus guruhlarni tashkil etish.

XULOSA

Xulosa o'rnida ta'kidlash joizki, oilaviy munosabatlarda konfliktlarning yuzaga kelishi muqarrar ijtimoiy-psixologik jarayon bo'lib, ularning o'z vaqtida oldi olinmasa, oila barqarorligiga putur yetkazadi. Ayniqsa, maxsus ehtiyojli farzandlar tarbiyalanayotgan oilalarda yuzaga keladigan ziddiyatlarni hal qilishda inklyuziv yondashuvlarga asoslangan psixologik yordam tizimini joriy etish eng maqbul yo'l hisoblanadi. Inklyuziv yondashuv oila a'zolarining bir-biriga nisbatan bag'rikengligini oshiradi, emotsional zo'riqishlarni kamaytiradi va sog'lom psixologik iqlimni yaratishga xizmat qiladi. Kelgusida ushbu yo'nalishda maxsus

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metodikalarni ishlab chiqish va amaliyotga tatbiq etish jamiyatimizdagi har bir oilaning mustahkamligi va farovonligini ta'minlashga ulkan xizmat qiladi.

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O‘ZBEKISTONDA INKLYUZIV TA‘LIMNI RIVOJLANTIRISHDA UNICEF BILAN HAMKORLIK

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Annotatsiya: *Mazkur tezisda inklyuziv ta‘limning mohiyati, O‘zbekistonda inklyuziv ta‘limning rivojlanishi, ta‘limga ehtiyojmand bolalarning ta‘lim olish imkoniyatlarini kengaytirishda UNICEF bilan faoliyati va bularni amalga oshirishdagi muammolar tahlil qilinadi. Shuningdek, yurtimizdagi inklyuziv ta‘limni rivojlantirish bo‘yicha farmon va qarorlar yoritiladi.*

Kalit so’zlar: *O‘zbekiston, inkyuziv ta‘lim, BMT, UNICEF, konsepsiya, SISF*

Abstract: *This thesis analyzes the essence of inclusive education, the development of inclusive education in Uzbekistan, cooperation with UNICEF in expanding educational opportunities for children with special educational needs, and the challenges in implementing these efforts. Additionally, it highlights the decrees, resolutions, and initiatives aimed at developing inclusive education in our country.*

Keywords: *Uzbekistan, inclusive education, UN, UNICEF, concept, SISF*

Аннотация: *В данной тезисе анализируются сущность инклюзивного образования, развитие инклюзивного образования в Узбекистане, деятельность совместно с ЮНИСЕФ по расширению возможностей получения образования детьми, нуждающимися в образовательных потребностях, а также проблемы реализации этих мер. Также освещаются указы, постановления и инициативы по развитию инклюзивного образования в нашей стране.*

Ключевые слова: *Узбекистан, инклюзивное образование, ООН, ЮНИСЕФ, концепция, SISF*

Bugungi globallashuv zamonida Jahon ta‘limi amaliyotida ta‘lim oluvchilar ehtiyojlariga moslashuvchan o‘quv muhitini yaratish, variativ o‘quv dasturlaridan foydalanishga bo‘lgan ehtiyoj kun sayin ortmoqda. Hozirda har bir davlatda inklyuziv ta‘limni joriy qilish zamon talabining eng muhim vazifalaridan biri bo‘lib qoldi. Shu qatori bizning yurtimizda ham bu borada keng ko‘lamli islohotlar amalga oshirilmoqda. Chunki har bir O‘zbekiston fuqorosi har qanday jismoniy holatidan

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qat‘iy nazar erkin bilim olishga huquqiga egadir. Shu borada imkoniyati cheklangan yoshlarimizni keng qamrovli maktabgacha ta‘lim tashkilotlariga qamrab olish va zamonaviy yondashuvlar asosida sifatli ta‘lim olishlari davlat tomonidan kafolatlangan.

Mamlakatimizda inklyuziv ta‘limni ta‘lim oluvchilarning ijtimoiy ehtiyojlari va shaxsiy manfaatlaridan kelib chiqqan holda fan, ta‘lim va ishlab chiqarishning mustahkam integratsiyasini ta‘minlash asosida tashkil etishning huquqiy - me‘yorlari ishlab chiqilgan. “Alohida ta‘lim ehtiyoji bo‘lgan bolalar uchun inklyuziv ta‘limni tashkil etish maqsadida ta‘lim muassasalari moddiy texnika bazasini mustahkamlash, o‘quv dasturlarini adaptivlashtirish, sog‘lomlashtiruvchi sifatli ta‘lim xizmatlari imkoniyatlarini oshirish hamda bu jarayonga mos yuqori malakali kadrlar tayyorlash” kabi muhim vazifalar belgilandi [1].

Bilamizki, mamlakatimizda amalga oshirilayotgan barcha islohotlar zamirida, eng avvalo, kelajak avlodning barkamol bo‘lib voyaga yetishi, hech kimdan kam bo‘lmay dunyo arenalarini zabt etishga qodir farzandlar bo‘lib yetishishi kabi dolzarb masalalarni hal etish turadi. Ayniqsa, yetim va ota-ona qaramog‘isiz qolgan, nogiron, rivojlanishida nuqsoni bor bolalarning ijtimoiy himoyasi hamisha davlat va jamiyatning ustuvor vazifasi bo’lib kelmoqda.

Inklyuziv ta‘lim davlat siyosati bo‘lib, nogiron va sog‘lom bolalar o‘rtasidagi to‘siqlarni bartaraf etish, inklyuziv ta‘limga muhtoj bolalarni rivojlanishidagi nuqsonlari yoki iqtisodiy qiyinchiliklaridan qat‘iy nazar, ijtimoiy hayotga moslashtirishga yo‘naltirilgan umumta‘lim jarayoniga qo‘shishni ifodalovchi ta‘lim tizimidir [2].

Bugungi kunda shunday bolalar borki, nogiron bo’lishiga qaramay, o’zining qobiliyati bilan barchani lol qila oladi. Ularni har tomonlama qo’llab – quvvatlash har birimizning muhim vazifamizdir. Zeroki, Vatanimiz kelajagi biz yoshlar qo’limizdadir. Buni chuqur anglagan holda har birimiz imkoniyatimizga yarasha harakat qilishimiz kerak. Inklyuziv ta‘limdan asosiy maqsad shuki, ijtimoiy kelib chiqishidan harbir bolani jamiyatning eng muhim bo‘lagi ekanligini tushuntirishdir. Ya‘ni imkoniyati cheklangan bolalarni alohida maktablarda emas, balki sog’lom bolalar bilan birgalikda qo‘shib o‘qitish, ijtimoiy holatidan qa‘tiy nazar, hammaning imkoniyati bir ekanligini tushuntirish eng muhim vazifalardan biridir. Azaldan ongimizga singib ketgan “sening imkoniyating cheklangan” degan iborani yo‘qotishiz kerak. Chunki kerak bo‘lsa ular qaysidir sohada sog’lom bolalardan ham ustun bo’la olishi mumkin. Bir so‘z bilan aytganda, jamiyat barchamizniki.

BMT 1975 - yilda “Nogiron shaxslar huquqlari to‘g‘risida”gi Deklaratsiyani qabul qildi. Mazkur Deklaratsiyada ta‘kidlanishicha: Xuddi shunday bolalarni huquqlarini muhofaza qilish maqsadida BMT 1989-yilda “Bolalar huquqlari

to‘g‘risidagi Konvensiya”ni qabul qildi. “Bolalar huquqlari to‘g‘risidagi Konvensiya” bolalarning huquqlarini hamma joyda himoyalash maqsadida ishlab chiqilgan inson huquqlari borasidagi xalqaro shartnoma hisoblanadi. U qariyb butun jahon mamlakatlari tomonidan ratifikatsiya qilingan. Konvensiyani ratifikatsiya qilgan 191 mamlakat ko‘ngilli tarzda zimmalariga “Bolalar huquqlari to‘g‘risidagi Konvensiya” qoidalarini ma‘muriy qonunchilik, sud va boshqa chora-tadbirlar yordamida hayotga tatbiq qilish majburiyatini oldilar. “Nogironlar shaxsiyatini hurmat qilish huquqi ularda tug‘ilishi bilan mavjud bo‘ladi. Nogironlikning kelib chiqishi, tabiati va jiddiylik darajasidan qat‘iy nazar, fuqaro o‘z yoshidagi tengdoshlari bilan bir xil huquqlarga egadirlarkim, shu bilan birga ular mumkin qadar to‘laqonli yaxshi hayot kechirish huquqiga ham ega” (“Nogiron shaxslar huquqlari to‘g‘risida”gi Deklaratsiya, 3-modda) [3].

2007-yildan beri Ijtimoiy tashabbuslarni qo‘llab-quvvatlash fondi (SISF) «O‘zbekistonda inklyuziv ta'lim» nomli dasturga rahbarlik qilib kelmoqda. Uning asosiy maqsadi nogironligi bo‘lgan barcha bolalar va o‘smirlar uchun ta'limda tenglikni targ‘ib qilishdan iborat. Ushbu strategiya boshlang‘ich sinflardan boshlab o‘rta maktablar va kollejlargacha davom etadigan bosqichma-bosqich inklyuziya modelini taklif qilish orqali o‘quvchilarning umrbod inklyuziv ta‘limini qo‘llab-quvvatlaydi hamda bu tizimda ta'limning umumiy sifatini yaxshilandi [4].

Fikrimcha, mazkur dastur O’zbekistonda inklyuziv ta’limni shakllantirish va rivojlantirish uchun muhim ahamiyat kasb etadi. Bu fond tomonidan ilgari surilgan inklyuziv ta’limni avval boshlang’ich sinflarga, keyinchalik yuqori sinflarga joriy qilish ta’limning uzviyligini va sifatini oshiradi. Chunki bosqichma – bosqich amalga oshirilgan ishlarda kadrlar masalasi ham alohida o’rin tutadi. Shuning uchun ham bunday ta’limni birdaniga joriy qilib bo’lmaydi.

O‘zbekiston Respublikasi Prezidenti Shavkat Mirziyoyevning 2020-yil 13-oktabrda qabul qilingan “Alohida ta‘lim olish ehtiyojlari bo‘lgan bolalarga ta‘lim-tarbiya berish tizimini yanada takomillashtirish chora-tadbirlari to‘g‘risida”gi qarori bunga yaqqol misol bo‘la oladi. Mazkur hujjatda mamlakatimizda inklyuziv ta’limni rivojlantirish imkonini beruvchi qator huquqiy va tashkiliy vazifalar belgilab berilgan. 2020-2025-yillarda inklyuziv ta‘limni rivojlantirish konsepsiyasi va “Yo‘l xaritasi” tasdiqlandi. Unda maxsus ta‘limga muhtoj bolalar ta‘limini tegishli davrgacha rivojlantirishning maqsadli ko‘rsatkichlari ishlab chiqilgan [5]. Bunda asosan inklyuziv ta‘limni dastlab kichik sinflarga, keyinchalik yuqori sinflarga qo‘llash nazarda tutilgan. Va pedagog kadrlarning malakasini oshirish uchun ularni qayta tayyorlash muhimligi uqtirildi. Tajriba sinovi uchun uni dastlab ayrim hududlarda qo‘llash tavsiya qilindi. Inklyuziv ta‘limning bu darajada muhim

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ekanligi yuqoridagi Prezidentimiz farmonlarida ham o‘z aksini topgan. Ammo buni amalga oshirishda bir qator bir qator muammolar bor:

1. Moddiy texnik muammolar (maxsus jihozlangan sinfxonalarning mavjud emasligi)

2. Kadrlar bilan bog‘liq muammolar (defektolog, logoped va boshqa kadrlar yetishmovchiligi)

3. Boshqarish va moliyaviy muammolar va hokazo.

Xulosa qilib aytadigan bo’lsak, UNICEF va O’zbekiston hamkorligida inklyuziv ta’lim bo’yicha qator islohotlar va uning ijrosi amalga oshirilmoqda. Bolalarning ta’lim olishini mustahkamlash va tenglik tamoyillarini qaror toptirish eng muhim vazifamiz bo’lib kelmoqda. Ularda vatanparvarlik hissini oshirish ham juda muihimdir. 2019-2025-yillar inklyuziv ta’lim rivoji uchun muhim poydevor bo’la oldi deb bemalol ayta olamiz. Inklyuziv ta’limning rivoji uchun malakali kadrlar va moddiy-texnik imkoniyatlar ham yetarlicha hal qilinmoqda. Jamiyatda o’zaro tenglik g’oyasi barchamiz uchun juda muhim ahamiyat kasb etadi. Unicef tomonidan ilgari surilgan har bir bolaning individual ta’lim olishiga ko’maklashish va ehtiyojlarini inobatga olgan holda ta’lim berish tamoyilining qo’llanilishi juda muhim yo’nalishlardan biridir. Zeroki har bir fuqaro O’zbekistonda ta’lim olish huquqiga bevosita egadir. Bu borada bir qancha tavsiyalarim mavjud:

- Maktablar uchun alohida inklyuziv ta‘lim bo‘yicha o‘quv kurslarini joriy qilish;
- Ota-onalar va mutaxassislar hamkorligini yo‘lga qo‘yish;
- Maktablarda kamsitilishning oldini olish;
- Xalqaro tajribani o‘rganib, amaliyotda qo‘llash va hokazo.

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UNIVERSAL TA'LIM DIZAYNI (UDL) OLIY TA'LIMDA INKLYUZIV PEDAGOGIKANI AMALGA OSHIRISH VOSITASI SIFATIDA

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Annotatsiya. *Tezisda o'qitishning universal dizayni (Universal Design for Learning, UDL) oliy ta'limda inklyuziv pedagogikani amalga oshirish vositasi sifatida tahlil qilinadi. Ish adabiyotlar sharhiga asoslangan bo'lib, unda inklyuziv pedagogika bilan UDL o'rtasidagi nisbat, UDLning uch tamoyili hamda ularning o'quv dasturi va baholashda qo'llanishi yoritiladi. Mavjud tizimli sharhlar UDL o'quv jarayonini yaxshilashini ko'rsatadi, biroq uning ta'lim natijalariga ta'siri hali yetarlicha isbotlanmagan. UDLning samarasi o'qituvchilarni tizimli tayyorlash va institutsional qo'llab-quvvatlashga bog'liq, degan xulosaga kelinadi.*

Kalit so'zlar: *o'qitishning universal dizayni, UDL, inklyuziv pedagogika, oliy ta'lim, inklyuziv baholash, o'qituvchilarning kasbiy rivojlanishi.*

Аннотация. *В тезисах универсальный дизайн обучения (Universal Design for Learning, UDL) рассматривается как инструмент реализации инклюзивной педагогики в высшем образовании. Работа основана на обзоре литературы и раскрывает соотношение инклюзивной педагогики и UDL, три принципа UDL и их применение при проектировании учебных программ и оценивания. Имеющиеся систематические обзоры показывают, что UDL улучшает процесс обучения, однако его влияние на образовательные результаты пока доказано недостаточно. Делается вывод, что эффективность UDL зависит от системной подготовки преподавателей и институциональной поддержки.*

Ключевые слова: *универсальный дизайн обучения, UDL, инклюзивная педагогика, высшее образование, инклюзивное оценивание, профессиональное развитие преподавателей.*

Abstract. *This paper examines Universal Design for Learning (UDL) as a tool for enacting inclusive pedagogy in higher education. Based on a review of the literature, it outlines the relationship between inclusive pedagogy and UDL, the*

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three UDL principles, and their application to curriculum and assessment design. Existing systematic reviews indicate that UDL improves the learning process, although its impact on educational outcomes has not yet been sufficiently demonstrated. The paper concludes that the effectiveness of UDL depends on sustained professional development for teaching staff and on institutional support.

Keywords: *Universal Design for Learning, UDL, inclusive pedagogy, higher education, inclusive assessment, professional development of teaching staff.*

Kirish

Oliy ta’limda talabalar tarkibi akademik, madaniy, ijtimoiy va til jihatidan tobora xilma-xil bo‘lib bormoqda. Bu holat o‘qituvchilardan har bir talaba to‘laqonli ishtirok eta oladigan o‘quv muhitini yaratishni talab qiladi. Inklyuziv pedagogika shu talabga javob beradi: u ayrim talabalar uchun alohida sharoit yaratish o‘rniga, odatda mavjud bo‘lgan imkoniyatlarni hamma uchun kengaytirishni nazarda tutadi [2].

Biroq inklyuziv pedagogika ko‘proq qadriyat va yondashuv bo‘lib, uni kundalik darsga qanday tatbiq etish masalasi ochiq qoladi. O‘qitishning universal dizayni (Universal Design for Learning, UDL) aynan shu bo‘shliqni to‘ldiruvchi amaliy vosita sifatida taklif etiladi. Ushbu tezis adabiyotlar sharhiga asoslangan bo‘lib, muallifning o‘z empirik ma’lumotlarini o‘z ichiga olmaydi. Uning maqsadi UDLning oliy ta’limdagi imkoniyatlari va cheklovlarini mavjud tadqiqotlar asosida ko‘rsatishdir.

Inklyuziv pedagogika va UDL nisbati

Inklyuziv pedagogika va UDL bir-birini to‘ldiruvchi ikki yondashuvdir: birinchisi o‘qituvchining e’tiqodi va qadriyatlarini belgilaydi, ikkinchisi ularni dars dizaynining aniq strategiyalariga aylantiradi [3]. Boshqacha aytganda, inklyuziv pedagogika “nima uchun” degan savolga, UDL esa “qanday qilib” degan savolga javob beradi.

Sanger [4] inklyuziv pedagogikaning tor va keng talqinini farqlaydi. Tor talqinda u nogironligi yoki alohida ehtiyoji bo‘lgan talabalarni qo‘llab-quvvatlashga qaratiladi, keng talqinda esa kelib chiqishi va sharoitidan qat’i nazar barcha talabalarga foyda keltiradi. UDL keng talqinga tayanadi: to‘siq talabaning o‘zida emas, balki o‘quv muhitining tuzilishida deb qaraladi. Shu sababli moslashuv muammo yuzaga kelgandan keyin emas, balki darsni rejalashtirish bosqichidayoq amalga oshiriladi.

Shu bilan birga, UDLni “shunchaki yaxshi o‘qitish” bilan tenglashtirish xato ekani adabiyotda alohida ta’kidlangan [10]. U ongli, oldindan rejalashtirilgan dizayn qarorlarini talab qiladi.

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UDLning uch tamoyili va oliy ta’limda qo‘llanishi

UDL konsepsiyasini CAST tashkiloti ishlab chiqqan bo‘lib, yo‘riqnomaning 3.0-tahriri 2024-yilda e’lon qilingan [1]. Yo‘riqnoma uch tamoyil asosida tuzilgan:

1. **Jalb qilishning ko‘p usullari (Multiple Means of Engagement):** talabaning qiziqishi va motivatsiyasini turli yo‘llar bilan qo‘llab-quvvatlash.
2. **Taqdim etishning ko‘p usullari (Multiple Means of Representation):** o‘quv materialini matn, audio, vizual va boshqa shakllarda berish.
3. **Harakat va ifodaning ko‘p usullari (Multiple Means of Action and Expression):** talabaga bilimini turli shakllarda namoyish etish imkonini berish.

Oliy ta’limda bu tamoyillar eng avvalo o‘quv dasturi va baholashda namoyon bo‘ladi. Uchinchi tamoyilga ko‘ra, o‘qituvchi bitta o‘quv natijasini esse, loyiha yoki taqdimot orqali baholashni taklif qilishi mumkin. Irlandiya universitetlaridan birida intellektual nogironligi bo‘lgan talabalar uchun dastur doirasida o‘tkazilgan keys-tadqiqotda talabalar baholashda bir necha shakl taklif etilishini foydali deb baholagan, chunki bu ularga bilimini qo‘shimcha moslashuvlarsiz ifodalash imkonini bergan [5].

Oliy ta’limdagi universal dizayn amaliyotiga oid 16 ta manbani (empirik tadqiqotlar va sharhlarni) qamragan tizimli sharh ham shunga yaqin xulosaga keladi. Unda moslashuvchan baholash, ko‘p shaklli o‘quv materiallari va qulay raqamli vositalar talabalarning ijobiy o‘quv tajribasi va faolligi bilan bog‘liq ekani ko‘rsatilgan [8]. CAST yo‘riqnomani tayyor retsept yoki nazorat ro‘yxati sifatida emas, balki aniq o‘quv maqsadiga qarab moslashtiriladigan tavsiyalar to‘plami sifatida taqdim etadi [1].

Dalillar bazasi va cheklovlar

UDL samaradorligi haqidagi dalillar ijobiy, ammo hali to‘liq emas. Capp [6] 2013–2016-yillarda chop etilgan 18 ta empirik tadqiqotni meta-tahlil qilib, UDL o‘quv jarayonini yaxshilashini, biroq uning ta’lim natijalariga ta’siri isbotlanmaganini aniqlagan. 2015–2021-yillardagi 13 ta tadqiqotni qamragan keyingi meta-tahlil umumiy ijobiy ta’sirni qayd etgan, lekin tadqiqotlarning natijalari bir-biridan sezilarli farq qilgan [7]. Oliy ta’limga oid sharhda esa aniq dizayn qarorlari bilan o‘quv natijalari o‘rtasidagi sabab-oqibat bog‘liqligi hali ko‘rsatilmagani ta’kidlanadi [8].

Ikkinchi cheklov amaliyot bilan bog‘liq. Buyuk Britaniya oliy ta’limiga oid tadqiqotlarda o‘qituvchilar ish yuklamasining og‘irligi va malaka oshirishdagi kamchiliklar inklyuziv o‘qitishga to‘sqinlik qiluvchi omillar qatorida ko‘rsatiladi

[11; 12]. Bunday sharoitda UDL tamoyillari hujjatlarda qolib, darsga yetib bormasligi mumkin. Universitet o‘qituvchilarini tayyorlashga bag‘ishlangan tizimli sharhga ko‘ra, UDL bo‘yicha maxsus o‘qitish ularning pedagogik kompetensiyasini oshiradi [9].

Xulosa

UDL inklyuziv pedagogika qadriyatlarini dars dizayniga aylantiruvchi amaliy vositadir: u inklyuziyani ayrim talabalarga beriladigan qo‘shimcha yordamdan barcha uchun oldindan rejalashtirilgan o‘quv muhitiga ko‘chiradi. Sharh asosida uchta xulosa qilish mumkin:

1. UDLni joriy etishni baholashdan boshlash mumkin: talabaga bilimini namoyish etish shaklini tanlash imkonini beruvchi moslashuvchan baholash sharhlarda ijobiy o‘quv tajribasi bilan izchil bog‘langan amaliyotlardan biridir.
2. UDL o‘z-o‘zidan natija bermaydi. Uning samarasi o‘qituvchilarning uzluksiz kasbiy rivojlanishi, ish yuklamasida dars dizayniga vaqt ajratilishi va institutsional qo‘llab-quvvatlashga bog‘liq.
3. Dalillar bazasi hali cheklangan, shuning uchun UDL joriy etilgan har bir holatda uning talabalar natijalariga ta’sirini o‘lchash zarur.

Bu xulosalar inklyuziv ta’limni rivojlantirayotgan boshqa mamlakatlar, jumladan O‘zbekiston oliy ta’lim muassasalari uchun ham amaliy ahamiyatga ega bo‘lishi mumkin.

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BÖLAJAK KIMYO ÖQITUVÇILARIDA KASBIY REFLEKSIYA VA INNOVATSION KOMPETENTLIKNING ÖZARO ALOQADORLIGI

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Annotatsiya. *Mazkur tezisda bölajak kimyo öqituvçilarining kasbiy refleksiyasi va innovatsion-pedagogik kompetentligi örtasidagi özaro aloqadorlik psixologik-pedagogik jihatdan asoslangan. J.Dyui, D.Şyon, D.Kolb, F.Kortxagen va A.V.Karpov ilmiy qaraşlari asosida refleksiya innovatsion faoliyatni ongli va tizimli xarakterga keltiruvçi psixologik mexanizm sifatida talqin qilingan. Refleksiyaning retrospektiv, situativ va perspektiv turlari innovatsion faoliyatning metodni tanlaş, darsda qöllaş va natijani baholaş bosqiçlari bilan boğlanib, ularning har biri kompetentlikning motivatsion-qadriyatli, kognitiv, operatsional-faoliyatli va refleksiv komponentlarini rivojlantirişdagi örni körsatilgan. Kimyo fanini öqitişning öziga xos jihatlari – laboratoriya tajribasi va raqamli simulyatsiyalar samarasini öquvçilar tuşunçasi orqali baholaş zarurati hisobga olingan holda refleksiv faoliyatni taşkil etiş vositalari taklif etilgan. Tezis natijalari bölajak kimyo öqituvçilarini tayyorlaş jarayonida pedagogik amaliyot va metodik maşğulotlarni takomillaştirişga xizmat qiladi.*

Kalit sözlar: *kasbiy refleksiya, refleksivlik, innovatsion-pedagogik kompetentlik, bölajak kimyo öqituvçisi, refleksiya turlari.*

Özbekiston Respublikasining “Ta’lim töğrisida”gi Qonunida pedagog kadrlarning kasbiy kompetentligini uzluksiz rivojlantiriş ta’lim sifatini ta’minlaşning muhim şarti sifatida belgilangan [1]. Innovatsion-pedagogik kompetentlik pedagogning yangilikni qabul qiliş, öz amaliyotiga moslaştiriş va uning samarasini baholaş qobiliyatini ifodalaydi [8; 9]. Bu jarayonning psixologik mexanizmi refleksiyadir. J.Dyui refleksiv fikrlaşni tajribani anglaş va undan xulosa çiqariş usuli sifatida asoslagan [2], D.Şyon esa “refleksiv amaliyotchi” konsepsiyasida mutaxassisning faoliyat davomida va undan keyin öz harakatlarini tahlil qiliş orqali kasbiy ösişini körsatgan [3]. D.Kolbning tajribaviy örganiş siklida refleksiv kuzatuv tajribadan yangi tuşunçaga ötişning zaruriy bosqiçi hisoblanadi

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[4]. F.Kortxagen esa öqituvçi tayyorlaşda çuqur refleksiyani taşkil etiş zarurligini asoslagan [5]. Kimyo öqituvçisi uçun refleksiya ayniqsa muhim: laboratoriya tajribasi yoki raqamli simulyatsiyani yangi şaklda qöllagan pedagog uning öquvçilar tuşunçasiga ta'sirini tahlil qila olmasa, innovatsiya tasodifiy xarakter kasb etadi.

Psixologik adabiyotlarda refleksivlik şaxsning öz faoliyatini anglaş, tahlil qiliş va boşqariş qobiliyatini ifodalovçi psixik xususiyat sifatida qaraladi. A.V.Karpov refleksivlikning retrospektiv, situativ va perspektiv şakllarini ajratadi [6]. Bu tasnif D.Şyonning "harakat içidagi" va "harakat haqidagi" refleksiya ğoyasi [3] hamda D.Kolbning tajribaviy örganiş sikli [4] bilan uyğun bölib, refleksiyani innovatsion faoliyatning har bir bosqiçi bilan boğlaş imkonini beradi.

Retrospektiv refleksiya bölajak kimyo öqituvçisining oldingi tajribasini tahlil qilib, yangi metodni tanlaş va darsni loyihalaş bosqiçida namoyon böladi; u kompetentlikning kognitiv va motivatsion-qadriyatli komponentlarini rivojlantiradi. Situativ refleksiya darsda innovatsion metodni qöllaş jarayonida pedagogga uni vaziyatga, masalan, laboratoriya tajribasining kutilmagan natijasiga moslaştiriş imkonini beradi va operatsional-faoliyatli komponentni mustahkamlaydi. Perspektiv refleksiya esa natijani baholaş va keyingi qadamni rejalaştiriş orqali refleksiv komponentning asosini taşkil etadi. Şunday qilib, refleksiya innovatsion faoliyatda "qöllaş – tahlil qiliş – qayta loyihalaş" siklini şakllantiruvçi boğlovçi mexanizm vazifasini bajaradi.

Kimyo öqituvçisi faoliyatida refleksiya ayniqsa muhim ahamiyat kasb etadi, çunki laboratoriya tajribasi yoki raqamli simulyatsiyaning samarasi öquvçilarning kimyoviy hodisalarni qanday tuşunganiga qarab baholanadi. A.K.Markova refleksiyani pedagog professionalizmining tayanç sifati deb hisoblaydi [7], E.Ğoziyev esa şaxsning öz-özini anglaşini uning faoliyatini boşqarişning psixologik asosi sifatida körsatadi [10]. F.Kortxagen ta'kidlaganidek, refleksiya faqat texnik harakatlarni emas, balki pedagogning kasbiy qadriyatlari va identikligini ham qamrab olsagina çuqur ta'sir körsatadi [5]. Şu sababli refleksiv faoliyat talabaning şaxsiy taşabbusiga qoldirilmasdan, refleksiv kundalik, mikrodars tahlili, dars tahlili protokoli va e-portfolio kabi vositalar orqali öquv jarayonining maxsus taşkil etilgan bosqiçiga aylantirilişi lozim.

Kasbiy refleksiya bölajak kimyo öqituvçisi innovatsion-pedagogik kompetentligining barça komponentlarini özaro boğlovçi psixologik mexanizm hisoblanadi. Uning retrospektiv, situativ va perspektiv turlari innovatsion faoliyatning metodni tanlaş, qöllaş va baholaş bosqiçlariga mos keladi. Kimyo öqitiş metodikasi maşğulotlari va pedagogik amaliyotda refleksiv faoliyatni tizimli taşkil etiş bölajak öqituvçilarda innovatsiyalarni ongli, asosli va samarali qöllaş

könikmalarini şakllantirişning muhim psixologik-pedagogik şarti bölib xizmat qiladi.

Olib borilgan tahlil asosida bölajak kimyo öqituvçilarida refleksiv faoliyatni rivojlantiriş böyiça quyidagi yönalişlarni belgilaş mumkin: birinçidan, kimyo öqitiş metodikasi maşğulotlarida har bir innovatsion metodni qöllaşdan söng uning samarasini öquvçilar tuşunçasi nuqtayi nazaridan tahlil qilişni majburiy bosqiç sifatida joriy etiş; ikkinçidan, pedagogik amaliyot davomida refleksiv kundalik va e-portfolio yuritişni tizimli taşkil etiş; uçinçidan, mikrodarslarni tengdoşlar va öqituvçi bilan birgalikda tahlil qiliş orqali jamoaviy refleksiya madaniyatini şakllantiriş; törtinçidan, refleksiyani faqat texnik harakatlar bilan çeklamasdan, bölajak öqituvçining kasbiy qadriyatlari va pedagogik identikligini anglaşga yönaltiriş. Mazkur yönalişlarning amalga oşirilişi bölajak kimyo öqituvçilarida innovatsiyalarga tanqidiy va ijodiy yondaşuvni, öz kasbiy faoliyatini mustaqil takomillaştiriş ehtiyojini şakllantiradi. Kelgusida refleksivlik va innovatsion-pedagogik kompetentlik örtasidagi aloqadorlikni A.V.Karpov metodikasi asosida empirik örganiş tadqiqotning istiqbolli yönalişi hisoblanadi.

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INGLIZ TILI DARSLARIDA BO‘LAJAK INGLIZ TILI O‘QITUVCHILARINING KREATIV FIKRLASHINI RIVOJLANTIRISH USULLARI

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Annotatsiya. *Ushbu maqolada oliy ta’lim muassasalarida bo‘lajak ingliz tili o‘qituvchilarini kasbiy tayyorlash jarayonida kreativ fikrlashni rivojlantirish masalasi ko‘rib chiqiladi. Tadqiqotning dolzarbligi reproduktiv ta’lim usullaridan interaktiv va ijodiy yondashuvlarga o‘tish zarurati bilan belgilanadi. Maqolada kreativlikning nazariy asoslari, xususan, J. Gilfordning divergent fikrlash va G. Uollesning ijodiy jarayon bosqichlariga oid qarashlari tahlil qilinadi. Shuningdek, talabalarning kreativ fikrlashini rivojlantirishga qaratilgan aqliy hujum, muammoli ta’lim, rolli o‘yinlar, geymifikatsiya hamda ijodiy ta’lim muhitini yaratish kabi amaliy usullar yoritiladi.*

Kalit so‘zlar: *kreativ fikrlash, bo‘lajak ingliz tili o‘qituvchilari, divergent fikrlash, aqliy hujum, muammoli ta’lim, rolli o‘yinlar, geymifikatsiya, oliy ta’lim.*

Аннотация. *В статье рассматривается проблема развития креативного мышления будущих учителей английского языка в процессе их профессиональной подготовки в высших учебных заведениях. Актуальность исследования обусловлена необходимостью перехода от репродуктивных методов обучения к интерактивным и творческим подходам. Анализируются теоретические основы креативности, в частности концепция дивергентного мышления Дж. Гилфорда и модель творческого процесса Г. Уоллеса. Рассматриваются практические методы развития креативного мышления студентов: мозговой штурм, проблемное обучение, ролевые игры, геймификация и создание творческой образовательной среды.*

Ключевые слова: *креативное мышление, будущие учителя, профессиональная подготовка, дивергентное мышление, интерактивные методы, геймификация.*

Abstract. *This article examines the development of creative thinking among future English language teachers during their professional training in higher education institutions. The relevance of the topic is associated with the need to move*

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from reproductive teaching methods towards interactive and creative approaches. The article discusses the theoretical foundations of creativity, particularly J. P. Guilford's concept of divergent thinking and G. Wallas's model of the creative process. It also outlines practical methods for developing students' creative thinking, including brainstorming, problem-based learning, role-play, gamification, and the creation of a supportive learning environment.

Keywords: *creative thinking, future teachers, professional training, divergent thinking, interactive methods, gamification.*

Kirish. Zamonaviy ta'lim islohotlari sharoitida chet tili o'qituvchisining kasbiy roli sezilarli darajada o'zgarib bormoqda. Bugungi o'qituvchidan nafaqat bilim berish, balki kreativ fikrlash, pedagogik muammolarga noodatiy yechimlar topish va dars jarayonida ijodiy muhit yaratish ham talab etiladi. Ingliz tili o'qituvchisi uchun muhim kompetensiyalardan biri — yangi g'oyalarni ishlab chiqish, o'zgaruvchan vaziyatlarga moslashish hamda o'quvchilarni darsga qiziqtiradigan innovatsion mashg'ulotlarni loyihalash qobiliyatidir.

Biroq bo'lajak o'qituvchilarni tayyorlashga qaratilgan an'anaviy dasturlarda ko'pincha lingvistik va metodik bilimlarni egallashga ustuvor ahamiyat beriladi. Natijada tayyor metodik andozalarni o'zlashtirishga ko'proq e'tibor qaratilib, kreativ fikrlash ko'nikmalarini rivojlantirish masalasi yetarlicha yoritilmasligi mumkin. Bu esa bo'lajak o'qituvchilarning kelajakdagi faoliyatida interaktiv, muammoli va loyihaga asoslangan ta'lim usullarini qo'llashda qiyinchiliklarga olib kelishi mumkin [1]. Shu sababli bo'lajak ingliz tili o'qituvchilarining kreativ fikrlashini rivojlantirishning nazariy asoslari va amaliy usullarini ko'rib chiqish muhim hisoblanadi. Mazkur maqolaning maqsadi kreativ fikrlashni rivojlantirishga xizmat qiluvchi yondashuv va metodlarni tahlil qilishdan iborat.

Asosiy qism. Kreativ fikrlashni rivojlantirish masalasini ilmiy jihatdan asoslash uchun psixologik va pedagogik konsepsiyalarga murojaat qilish zarur. Jumladan, amerikalik psixolog J. P. Gilford tomonidan tavsiflangan divergent fikrlash kreativlikning muhim tarkibiy jihatlaridan biri hisoblanadi. Konvergent fikrlashdan farqli ravishda, divergent fikrlash muayyan muammoni hal etish uchun bir nechta muqobil va original g'oyalarni ishlab chiqishga imkon beradi [2]. Bo'lajak ingliz tili o'qituvchisi faoliyatida bu, masalan, Present Perfect grammatik mavzusini faqat bitta standart usulda emas, balki o'quvchilarning bilim darajasi va idrok xususiyatlariga mos turli usullar orqali tushuntira olishda namoyon bo'ladi.

Ijodiy jarayonning ichki dinamikasini G. Uolles taklif etgan to'rt bosqichli model orqali izohlash mumkin [3]:

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1. Tayyorgarlik (Preparation) — dastlabki ma’lumotlarni to‘plash va mavjud pedagogik yondashuvlarni tahlil qilish.

2. Inkubatsiya (Incubation) — muammo ustida bevosita ishlash vaqtincha to‘xtatilganida, uning yechimi ong ostida shakllanishi.

3. Yoritilish (Illumination) — yangi g‘oya, noodatiy yechim yoki o‘ziga xos dars rejasining yuzaga kelishi.

4. Tekshirish (Verification) — taklif etilgan g‘oyani tanqidiy baholash va uni real ta’lim sharoitlariga moslashtirish.

Ushbu bosqichlarni hisobga olish oliy ta’lim o‘qituvchilariga talabalarning ijodiy faoliyatini maqsadli tashkil etish va puxta ishlab chiqilgan pedagogik loyihalar ustida ishlashlari uchun yetarli vaqt ajratish imkonini beradi.

Ingliz tili va uni o‘qitish metodikasi bo‘yicha amaliy mashg‘ulotlarda quyidagi usullardan foydalanish mumkin:

1. Aqliy hujum va aqliy xarita

Aqliy hujum (brainstorming) usuli A. F. Osborn nomi bilan bog‘liq. Ushbu yondashuv g‘oyalarni erkin ilgari surish va ularni keyinchalik tahlil qilishga asoslanadi [4]. Mashg‘ulot davomida bo‘lajak o‘qituvchilarga, masalan, “Education” mavzusi bo‘yicha uch daqiqa ichida imkon qadar ko‘proq assotsiatsiya va g‘oyalarni yozish topshiriladi. Keyingi bosqichda ular metodlar, baholash va texnologiyalar kabi toifalarga ajratiladi. Aqliy xarita esa g‘oyalar o‘rtasidagi bog‘liqlikni vizual tarzda ko‘rsatishga yordam beradi.

2. Muammoli ta’lim (Problem-Based Learning)

J. Dyuining qarashlarida tajriba va refleksiyaning ta’lim jarayonidagi ahamiyati alohida o‘rin tutadi [5]. Muammoli ta’limda bo‘lajak o‘qituvchilarga dars jarayonida yuzaga kelishi mumkin bo‘lgan, odatiy usullar bilan hal etish qiyin bo‘lgan real yoki modellashtirilgan pedagogik vaziyatlar taqdim etiladi. Masalan: “Bir guruh o‘quvchilar juftlikda ingliz tilida gaplashishdan bosh tortmoqda. Ularning muloqotga kirishishini ta’minlash uchun uchta kreativ usul taklif eting”. Bunday topshiriq til bilimlari bilan bir qatorda divergent fikrlashni ham talab etadi. Yana bir vaziyat: “Siz multimedia taqdimotidan foydalanishni rejalashtirgan darsni o‘tkazmoqdasiz, biroq maktabda elektr ta’minoti uzilgan. Proyektor va bosma darsliklardan foydalanish imkoniyati yo‘q. Darsni samarali davom ettirish uchun qanday choralar ko‘rasiz?” Bunday topshiriqlar bo‘lajak o‘qituvchilarni odatiy algoritmlardan tashqarida fikrlashga, mavjud resurslardan oqilona foydalanishga va muqobil pedagogik yechimlar ishlab chiqishga undaydi.

3. Rolli o‘yinlar va pedagogik simulyatsiyalar

L. S. Vigotskiy ijodiy tasavvurning inson tajribasi boyligi va xilma-xilligiga bog‘liqligini ta’kidlaydi [6]. Rolli o‘yinlar (suhbat, pedagogik kengash, ekskursiya-

dars) bo‘lajak o‘qituvchilarga improvizatsiya qilish, vaziyatga tezkor munosabat bildirish va tabiiy muloqot olib borish imkonini beradi. Bu usul xato qilishdan qo‘rqishni kamaytirib, mustaqil va moslashuvchan fikrlashni faollashtiradi. Masalan, bir talaba o‘qituvchi rolini bajaradi, qolgan talabalar esa turli xususiyatlarga ega o‘quvchilar obrazini tanlaydi: faol, sust yoki til to‘sig‘iga duch kelayotgan o‘quvchi. Bo‘lajak o‘qituvchining vazifasi barcha ishtirokchilarni darsga jalb etishdan iborat. Buning uchun u o‘qitish usullarini vaziyatga moslashtirishi, improvizatsiya qilishi va har bir o‘quvchiga individual yondashuvni tanlashi kerak.

4. O‘yin texnologiyalari va geymifikatsiya

Kreativlik zamonaviy ta’lim vositalaridan maqsadli foydalanish qobiliyati bilan ham bog‘liq. Talabalarga Kahoot va Baamboozle kabi platformalar imkoniyatlarini o‘rganish, shuningdek, ular yordamida o‘quv topshiriqlarini mustaqil loyihalash vazifasi berilishi mumkin. Masalan, odatiy grammatika testi yoki lug‘at mashqini o‘yin elementlariga asoslangan topshiriqqa aylantirib, uni dars maqsadlariga moslashtirish talab etiladi. Bu jarayon texnologik kreativlikni rivojlantiradi hamda geymifikatsiyani shunchaki ko‘ngilochar vosita emas, balki didaktik yondashuv sifatida qo‘llashga o‘rgatadi.

5. Ijodiy ta’lim muhitini yaratish

K. R. Rojersning inson salohiyatini ro‘yobga chiqarish va ijodiy rivojlanish haqidagi qarashlari ta’lim jarayonida qo‘llab-quvvatlovchi muhitning ahamiyatini ko‘rsatadi [7]. Bo‘lajak o‘qituvchilarning kreativ fikrlashini rivojlantirish uchun oliy ta’lim o‘qituvchilari quyidagi shart-sharoitlarni yaratishi maqsadga muvofiq:

— turli va muqobil javoblarni rag‘batlantirish;

— xato va kamchiliklarni o‘rganish jarayonining tabiiy qismi sifatida qabul qilish;

— mustaqil qaror qabul qilishni talab etadigan ochiq topshiriqlar berish (masalan, Past Simple mavzusini o‘rgatish uchun yangi o‘yin ishlab chiqish).

Xulosa. Bo‘lajak ingliz tili o‘qituvchilarida kreativ fikrlashni rivojlantirish izchil va maqsadli pedagogik yondashuvni talab etadi. Divergent fikrlashga yo‘naltirilgan topshiriqlar, kasbiy vaziyatlarni tahlil qilish, rolli o‘yinlar va geymifikatsiya talabalarning pedagogik muammolarga mustaqil hamda muqobil yechimlar topish ko‘nikmalarini rivojlantirishga xizmat qiladi.

Shu bois oliy ta’lim muassasalarida e’tiborni bilimlarni faqat reproduktiv o‘zlashtirishga emas, balki bo‘lajak o‘qituvchilarning ijodiy salohiyatini namoyon etishi uchun sharoit yaratishga ham qaratish lozim. Bunday yondashuv kelajakdagi pedagogik faoliyat samaradorligini oshirish va maktablarda chet tilini o‘qitish sifatini yaxshilashga xizmat qilishi mumkin.

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2. EXACT AND NATURAL SCIENCES: FUNDAMENTAL RESEARCH, INTERDISCIPLINARY STUDIES AND PRACTICAL OUTCOMES.

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PEROVSKIA SCROPHULARIIFOLIA BUNGE O‘SIMLIGI TARKIBIDAGI BIOLOGIK FAOL BIRIKMALAR

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Annotatsiya. *Ushbu maqolada Lamiaceae oilasiga mansub Perovskia scrophulariifolia Bunge - muhallisbargli qisroq o‘simligining yer ustki qismlari — bargi, poyasi va gullarida uchraydigan biologik faol birikmalar, jumladan, efir moylari, diterpenoidlar, flavonoidlar, fenolik birikmalar, glikozidlar va fitosterollarning kimyoviy xususiyatlari va farmakologik ahamiyati ilmiy adabiyotlarda keltirilgan ma’lumotlar asosida tahlil qilindi.*

Kalit so‘zlar: *Perovskia scrophulariifolia, efir moyi, diterpenoidlar, flavonoidlar, fenolik birikmalar, antioksidant, antimikrob faollik.*

Аннотация*. В данной статье на основе научной литературы проанализированы биологически активные соединения, содержащиеся в надземных частях растения Perovskia scrophulariifolia Bunge — мухаллисбаргли кисрок, относящегося к семейству Lamiaceae, включая эфирные масла, дитерпеноиды, флавоноиды, фенольные соединения, гликозиды и фитостеролы, а также рассмотрены их химические свойства и фармакологическое значение.*

Ключевые слова: *Perovskia scrophulariifolia, эфирные масла, дитерпеноиды, флавоноиды, фенольные соединения, антиоксидантная активность, антимикробная активность.*

Abstract. *This article analyzes biologically active compounds found in the aerial parts (leaves, stems, and flowers) of Perovskia scrophulariifolia Bunge, a member of the family Lamiaceae, based on scientific literature. Particular attention is given to essential oils, diterpenoids, flavonoids, phenolic compounds, glycosides, and phytosterols, as well as their chemical properties and pharmacological significance.*

Keywords*: Perovskia scrophulariifolia, essential oils, diterpenoids, flavonoids, phenolic compounds, antioxidant activity, antimicrobial activity.*

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Kirish. Dorivor o‘simliklar tarkibidagi biologik faol birikmalar farmatsevtika, tibbiyot va oziq-ovqat sanoatida muhim tabiiy xomashyo manbalaridan biri hisoblanadi. Ayniqsa, Lamiaceae oilasi vakillari efir moylari, terpenoidlar, fenolik birikmalar va flavonoidlarga boyligi bilan ajralib turadi. Ushbu oilaga mansub *Perovskia scrophulariifolia* Bunge Markaziy Osiyo, jumladan, O‘zbekiston florasida uchraydigan aromatik dorivor o‘simliklardan biridir.[1]

Adabiyotlar tahlili. *Perovskia scrophulariifolia* hayotiy shakliga ko’ra yarim buta, balandligi 60–120 sm, poya yuqori qismidagi barglari cho‘zinchoq-lansetsimon, gullari binafsha rangda siyrak shingil to’pgulda joylashgan. O‘simlik iyun–iyul oylarida gullaydi, iyul–avgust oylarida meva beradi. O’simlikning tabiiy zahiralari O‘rta Osiyo hududlarini (Tyanshan (Farg‘ona tizmasi) hamda Pomir-Olay (Zarafshon tizmasi) tog‘ tizimlari) qamrab oladi. [2,3]

O‘simlikning yer ustki qismlari tarkibida turli kimyoviy tabiatga ega biologik faol moddalar aniqlangan. Takeda va hammualliflar tomonidan olib borilgan tadqiqotlarda o‘simlikning yer ustki qismlaridan 11 ta birikma rosmanol, epirosmanol, karnozol, 12-O-metilkarnosin kislotasi, diosmetin, eugenol-β-D-glyukopiranozid, salidrozid, benzil spirti-β-D-glyukopiranozid, uridin va boshqa glikozidlar ajratib olingan. Aniqlangan birikmalarning aksariyati fenolik diterpenoidlar va glikozidlar guruhiga mansub [4]. 2020–2021-yillardagi tadqiqotlarida *P. scrophulariifolia* yer ustki qismlaridan yangi tuzilishga ega perovsfolin A, B, C va D kabi terpenoid birikmalar tavsiflangan. 2021-yilgi tadqiqotda jami 15 ta diterpenoid ajratib olingan bo‘lib, ulardan ikkitasi yangi 20-norabietan tipidagi diterpenoidlar — perovsfolin C va D hisoblanadi [5,6]. Ushbu birikmalarning ayrimlari mikroglial hujayralarda neyroyallig‘lanishga qarshi faolligi nuqtayi nazaridan ham o‘rganilgan.

O‘simlikning muhim kimyoviy tarkibiy qismi efir moylari bo’lib, Dzhumaev va Tkachenko tomonidan O‘zbekistonda o‘sadigan *P. scrophulariifolia* o‘simligining barglari, to‘pgullari va poyalaridagi efir moylari tarkibi gaz xromatografiyasi va mass-spektrometriya usullari yordamida o‘rganilgan. Tadqiqot natijalariga ko‘ra, gullash davrida barglarda efir moyi miqdori 0,71%, to‘pgullarda esa 0,65% ni tashkil etgan. Poyalarda efir moyi nisbatan kam miqdorda uchrashi aniqlangan. Efir moyi tarkibida barglardan 26 ta, to‘pgullardan 43 ta va poyalardan 18 ta komponent identifikatsiya qilingan. Asosiy komponentlar qatorida 1,8-sineol (19,3% gacha) va izobornil atsetat (15,9% gacha) qayd etilgan [7].

2025-yilda Samarqand viloyatining Omonqo‘ton qishlog‘i atroflaridan o‘suvchi Perovskia scrophulariifolia o‘simligining yer ustki qismi va ildizining metanol ekstraktidan karnozol, sirsimarin, stigmasterol va β-sitosterol va boshqa

birikmalar tahlil qilingan. Ildizlarning metanolli ekstraktini fraksiyalash natijasida 8 ta individual birikma ajratib olingan. [8].

№	Kimyoviy birikma	Kimyoviy sinfi	Ajratilgan miqdori
1	Kriptotanshinon (Cryptotanshinone)	Diterpenoid	8,3 g
2	Tanshinon IIA (Tanshinone IIA)	Diterpenoid	25 mg
3	Prevalskin Y-1 (Przewalskin Y-1)	Diterpenoid	14 mg
4	Grandifolin B (Grandifolin B)	Diterpenoid	12 mg
5	Stigmasterol	Fitosterol	1,24 g
6	Rozmarin kislotasi (Rosmarinic acid)	Fenol kislotasi	0,43 g
7	Kofe kislotasi (Caffeic acid)	Fenol kislotasi	0,37 g
8	D-pinitol	Siklitol	6,3 g

Aniqlangan birikmalar farmokologik xususiyatlarga ega. Masalan, karnozol antioksidant va yallig‘lanishga qarshi xususiyatlari bilan, flavonoidlar erkin radikallarni neytrallash salohiyati bilan, efir moylari komponentlari esa antimikrob faolligi bilan e’tiborga loyiq. Bundan tashqari, ayrim diterpenoidlar neyroyallig‘lanishga qarshi faollikga ega. Mazkur o‘simlik xalq tabobatida teri kasalliklari, dermatit, quyosh ta’sirida yuzaga kelgan kuyishlar va ayrim ichak parazitlariga qarshi an’anaviy tarzda qo‘llaniladi [4].

Xulosa. *Perovskia scrophulariifolia* Bunge o‘simligining yer ustki qismlarida efir moylari, abietan tipidagi diterpenoidlar, flavonoidlar, fenolik birikmalar, glikozidlar va fitosterollar mavjudligi ilmiy tadqiqotlarda aniqlangan. Mazkur birikmalarning antioksidant, antimikrob va yallig‘lanishga qarshi faolligi bo‘yicha olingan dastlabki natijalar o‘simlikning farmakologik salohiyatini o‘rganish uchun muhim asos yaratadi.

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3. ARTIFICIAL INTELLIGENCE, DIGITAL TECHNOLOGIES AND ENGINEERING: INNOVATIVE SOLUTIONS AND TECHNOLOGICAL PROGRESS.

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ESP-NOW ASOSIDAGI MASTER–SLAVE BOSHQARUV ARXITEKTURASI VA KONVEYER BILAN SINXRONLASH ALGORITMLARINI MODELLASHTIRISH

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Annotatsiya. *Maqolada ESP32 mikrokontrollerlari va ESP-NOW protokoli asosida PUMA tipidagi manipulyator uchun master–slave boshqaruv arxitekturasi, 26 baytlik paket formati (CRC16, ketma-ketlik raqami, heartbeat) va konveyer bilan sinxronlash algoritmlari (stop-and-pick, moving-pick) taklif etilgan hamda modellashtirish orqali baholangan. Modelga ko‘ra, master→slave kechikishning P99 qiymati ≈3,5 ms, 200 Hz setpoint oqimida 30 % paket yo‘qolishi setpointda 1,3° dan kam og‘ish beradi. Monte-Karlo tajribasida (har bir tezlikda 4000 urinish) moving-pick kechikish kompensatsiyasi bilan 12 sm/s gacha ≥95 % muvaffaqiyat, kompensatsiyasiz esa ≈7 sm/s gacha beradi. Natijalar real stendda tasdiqlanishi kerak.*

Kalit so‘zlar: *ESP-NOW, master–slave, konveyer, moving-pick, kechikish, manipulyator, modellashtirish.*

Аннотация. *В статье предложена архитектура «ведущий–ведомый» на базе микроконтроллеров ESP32 и протокола ESP-NOW для манипулятора типа PUMA (26-байтовый пакет, CRC16, порядковый номер, heartbeat), а также алгоритмы синхронизации с конвейером (stop-and-pick, moving-pick), оценённые моделированием. По модели P99 задержки «ведущий→ведомый» составляет ≈3,5 мс, а потеря 30 % пакетов в потоке уставок 200 Гц даёт отклонение менее 1,3°. В эксперименте Монте-Карло (4000 попыток на скорость) moving-pick с компенсацией задержки обеспечивает ≥95 % успешных захватов до 12 см/с, без компенсации — до ≈7 см/с. Результаты требуют подтверждения на стенде.*

Ключевые слова: *ESP-NOW, ведущий–ведомый, конвейер, moving-pick, задержка, манипулятор, моделирование.*

Abstract. *The paper proposes a master–slave control architecture for a PUMA-type manipulator based on ESP32 microcontrollers and the ESP-NOW protocol (26-byte packet, CRC16, sequence number, heartbeat) together with conveyor*

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synchronisation algorithms (stop-and-pick, moving-pick), evaluated by simulation. In the model, the P99 master→slave latency is ≈3.5 ms, and 30 % packet loss in a 200 Hz setpoint stream causes a setpoint deviation below 1.3°. In a Monte Carlo study (4000 trials per speed), moving-pick with latency compensation achieves ≥95 % success up to 12 cm/s, and ≈7 cm/s without compensation. The results require validation on a physical test bench.

Keywords: *ESP-NOW, master–slave, conveyor, moving-pick, latency, manipulator, simulation.*

Kirish

Manipulyatorni konveyer liniyasi bilan birlashtirish arzon o‘quv-tadqiqot majmualarida ham, kichik avtomatlashtirilgan liniyalarda ham dolzarb masala bo‘lib, uni hal qilish uchun boshqaruv qismlari o‘rtasida past kechikishli va ishonchli aloqa hamda detalning harakatini hisobga oluvchi sinxronlash algoritmi talab etiladi. ESP-NOW — Espressif ishlab chiqqan, Wi-Fi infratuzilmasiz ishlovchi, bog‘lanishsiz protokol bo‘lib, bitta paketda 250 baytgacha foydali yuk uzatadi [1].

ESP-NOW ning kechikishi va ishonchliligi turli sharoitlarda eksperimental o‘rganilgan. Pastki oyoq-qo‘l ekzoskeleti tizimi uchun o‘tkazilgan taqqoslashda ESP-NOW UDP ga nisbatan sezilarli kam kechikishni ko‘rsatgan, ammo tugunlar soni birdan to‘rtgacha oshganda paket yo‘qolishi o‘sgan (maksimal 8,6 %) [2]. Yuqori chastotali sanoat telemetriyasida ESP-NOW va Wi-Fi (UDP) solishtirilganda ESP-NOW taxminan 2,4 ms kechikish va ancha kichik jitterni ko‘rsatgan [3]; shaharda ESP-NOW asosidagi VANET prototipi kechikish va paket yo‘qolishi bo‘yicha statistik baholangan [4]. Bu natijalar aloqa kanali sifati qurilma soni, masofa va muhitga bog‘liqligini, shu sababli har bir tizim uchun alohida baholash zarurligini bildiradi.

Konveyerdan harakatdagi detalni olish masalasida ish unumdorligi konveyerni to‘xtatmasdan ushlashni talab qiladi, bunda robot detalning kelajakdagi o‘rniga oldindan yo‘nalishi kerak va xato lenta tezligiga proporsional ortadi. Kechikishni tezlikka qo‘shimcha tuzatma bilan kompensatsiya qilish g‘oyasi sanoat konveyer-kuzatuv usullarida uzoq vaqtdan beri qo‘llanadi [5]; zamonaviy ishlarda esa ushlash muvaffaqiyati tezlikka bog‘liq holda o‘rganiladi: masalan, ko‘p barmoqli ushlagich 20…220 mm/s tezlik oralig‘ida o‘rtacha 71,7 % muvaffaqiyat bergan [6], vizual servo kuzatuvda esa barqaror kuzatuv tezligi modelda ≈0,25 m/s, real sharoitda ≈0,3 m/s atrofida bo‘lgan [7]. PUMA 560 uchun ochiq arxitekturali kontrollerlar [8] mavjud bo‘lsa-da, ularda ko‘pincha bitta o‘q ko‘rib chiqilgan va konveyer bilan simsiz sinxronlash masalasi qamralmagan.

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Maqolaning maqsadi — ESP-NOW asosidagi master–slave arxitekturasi va xavfsiz to‘xtash mexanizmlariga ega protokolni taklif etish, konveyer bilan sinxronlashning ikki rejimini (stop-and-pick va moving-pick) kechikish, jitter va tezlik o‘lchash xatosini hisobga olgan holda modellashtirish orqali baholash hamda ishonchli ishlash tezlik chegarasini aniqlashdir. Ish muallifning magistrlik dissertatsiyasi [9] natijalariga asoslangan.

Arxitektura va aloqa protokoli

Tizim bitta master va slave ESP32 modullaridan iborat (har bir slave bir necha bo‘g‘inni boshqaradi). Master vazifa darajasini (holat mashinasi, konveyer rejalashtiruvchisi, ≈10 Hz) va trayektoriya darajasini (teskari kinematika, bo‘g‘in fazosida trayektoriya, 50–200 Hz) bajaradi hamda setpointlarni ESP-NOW orqali yuboradi. Slave’lar pozitsiya konturini (200 Hz, T_s = 5 ms), tezlik/tok konturini (1 kHz) va PWM ni (20 kHz) mahalliy bajaradi; shu tufayli aloqa kechikishi qisqa vaqtli bo‘lsa-da, tezkor kontur aloqaga bog‘liq emas.

Boshqaruv va telemetriya paketlari atigi 26 bayt (1-jadval): magik bayt (0xA5), tur, tugun identifikatori, rejim, ketma-ketlik raqami (SEQ), bayroqlar (FLG), uchta suzuvchi nuqtali qiymat (setpoint, maksimal tezlik, tezlik feedforward), vaqt tamg‘asi va CRC16-CCITT. SEQ yo‘qolgan va takrorlangan paketlarni aniqlaydi, vaqt tamg‘asi kechikishni baholash va eskirgan paketlarni rad etish uchun ishlatiladi. Slave paketni faqat magik bayt, CRC, tur va ID tekshiruvlaridan o‘tgandan so‘ng, SEQ oldingisidan yangi bo‘lsa qabul qiladi. Paket yo‘qolsa, slave oxirgi qabul qilingan setpointni ushlab turadi. Master 100 ms davri bilan heartbeat yuboradi; 100 ms (200 Hz da 20 ta ketma-ket paket) davomida to‘g‘ri paket kelmasa, slave aloqa uzilishi bayrog‘ini o‘rnatib, xavfsiz to‘xtash rejimiga o‘tadi (PWM → 0). Dasturiy xavfsizlik apparat E-STOP zanjirining o‘rnini bosmaydi: favqulodda to‘xtatish dasturdan mustaqil, ikki kanalli rele va kontaktor orqali ta’minlanadi (ISO 13850 talablariga yo‘naltirilgan) [10].

1-jadval. Boshqaruv paketi (master→slave) maydonlari, jami 26 bayt

Maydon	Bayt	Vazifasi
magic, type, id, mode	4	Magik bayt 0xA5; paket turi (boshqaruv, telemetriya, buyruq); maqsad tugun; rejim (OFF, RUN, HOME)
seq	2	Ketma-ketlik raqami: yo‘qolgan va takrorlangan paketlarni aniqlash
flags	2	Bayroqlar: E-STOP, aloqa, chegara, to‘xtab qolish, enkoder xatosi, homing bajarilgan
setpointDeg, vmaxDegS, vffVolt	12	Setpoint (°), maksimal tezlik (°/s), tezlik feedforward (V) — uchta float
tMs	4	Vaqt tamg‘asi: kechikishni baholash va eskirgan paketlarni rad etish

Maydon	Bayt	Vazifasi
crc	2	CRC-16/CCITT-FALSE nazorat yig‘indisi

Slave resurslari bo‘yicha taxminiy baho (3 bo‘g‘in uchun): boshqaruv vazifasi bajariladigan yadro ≈2 % ga yuklanadi, aloqa va Wi-Fi yadrosi ≈10–20 %, statik RAM 30 KB dan kam, dastur xotirasi ≈400–600 KB; bu zaxira konveyer logikasi, telemetriya va diagnostika qo‘shishga imkon beradi. Bu qiymatlar ham real o‘lchovlar bilan aniqlashtirilishi kerak.

Konveyer bilan sinxronlash algoritmlari

Stop-and-pick. Detal S1 fotodatchigidan o‘tgach konveyer to‘xtatiladi, robot qo‘zg‘almas detalni oladi. Ushlash xatosi faqat robotning pozitsion aniqligi va datchik joylashuviga bog‘liq, ammo konveyerning to‘xtashi ish unumdorligini kamaytiradi.

Moving-pick. Konveyer to‘xtamaydi. S1 datchigi t_0 vaqtda ishga tushganda detal x_0 koordinatada bo‘ladi; filtrlangan lenta tezligi $\hat{v}$ lenta enkoderidan olinadi. Ushlash vaqti va nuqtasi quyidagicha rejalashtiriladi:

$$t_c = t_0 + T_{lat} + T_{plan} + T_{move}; \quad x_{pick} = x_0 + \hat{v}\,(T_{lat} + T_{plan} + T_{move}) \qquad (1)$$

bu yerda T_{lat} — datchik va aloqa kechikishi (oldindan o‘lchab kalibrlanadi), T_{plan} — hisoblash vaqti, T_{move} — robotning ushlash nuqtasigacha harakat vaqti. Kechikish jitteri σ_{lat} va tezlik o‘lchash xatosi δv ushlash xatosini hosil qiladi:

$$\delta x \approx v\,\sigma_{lat} + \delta v\,T_{move}, \quad v_{max} \approx \delta_g / (\sigma_{lat} + \varepsilon_v\,T_{move}) \qquad (2)$$

bu yerda δ_g — ushlagich og‘zi tolerantligi (±), ε_v — tezlikning nisbiy xatosi. Algoritm x_{pick} ni ish zonasi bilan tekshiradi, teskari kinematikani yechadi (chegara va singulyarlik nazorati bilan), muvaffaqiyatsiz bo‘lsa detalni o‘tkazib yuboradi, so‘ng trayektoriyani kvintik profil bilan slave’larga yuboradi va har bosqichda kuzatuv xatosi, aloqa uzilishi hamda E-STOP ni tekshiradi. Jarayon holat mashinasi (IDLE → HOMING → WAIT_PART → PLAN → APPROACH → GRASP → TRANSFER → RELEASE → RETURN) sifatida amalga oshiriladi, istalgan holatdan FAULT ga o‘tish mumkin.

Modellashtirish metodikasi

Master→slave bir tomonlama kechikish gamma-taqsimot bilan modellashtirildi (o‘rtacha ≈1,65 ms, P99 = 3,5 ms, maksimum ≈5,3 ms); bu taxminiy kutilgan qiymatlarga asoslangan va real o‘lchovlar bilan almashtirilishi kerak. Paket yo‘qolishi tajribasida 1 s davomida 35° li harakat 200 Hz setpoint oqimi bilan yuborildi, yo‘qolish ehtimoli 10, 30 va 50 % deb olindi. Konveyer tajribasi Monte-Karlo usulida (har bir tezlikda 4000 urinish) bajarildi: ushlagich tolerantligi ±10 mm, robotning o‘rnatilgan pozitsion xatosi N(1,5; 0,8) mm, T_{move} = 1,9 s, lenta tezligining nisbiy xatosi 2 %, datchik va aloqa kechikishi jitteri σ = 6 ms, kompensatsiyalanmagan kechikish 45 ms. Uch variant solishtirildi: stop-and-pick,

kechikishi kompensatsiya qilingan moving-pick va kompensatsiyasiz moving-pick. **Barcha natijalar modellashtirish natijalari bo‘lib, real stendda tasdiqlanishi kerak.**

Natijalar va muhokama

5.1. Aloqa. Modelda P99 kechikish 3,5 ms bo‘lib, pozitsion kontur davridan (5 ms) kichik. Setpoint oqimidagi yo‘qolish ta’siri uncha katta emas: 10, 30 va 50 % yo‘qolishda slave ko‘rgan setpointning ideal profildan maksimal og‘ishi mos ravishda 0,32°, 1,26° va 2,24° ni tashkil etdi (2-jadval); bunday «pog‘ona»ni PID kontur silliqlaydi. Aloqa taymauti ishga tushishi uchun ketma-ket 20 ta paket yo‘qolishi kerak; yo‘qolishlar mustaqil deb olinsa, bu hodisa ehtimoli 30 % da $0{,}3^{20} \approx 3{,}5\cdot10^{-11}$, 50 % da $0{,}5^{20} \approx 9{,}5\cdot10^{-7}$, ya’ni soxta ishga tushish juda kam. Real muhitda yo‘qolishlar shovqin portlashlari tufayli korrelyatsiyalangan bo‘lishi mumkin, shuning uchun bu baho quyi chegara hisoblanadi. Natijalar [2, 3] dagi o‘lchovlar bilan tartib jihatidan mos (bir necha millisekund), biroq qurilma, muhit va yuklama boshqacha bo‘lgani uchun to‘g‘ridan-to‘g‘ri taqqoslab bo‘lmaydi.

2-jadval. Paket yo‘qolishining setpointga ta’siri (35° harakat, 1 s, 200 Hz oqim)

Yo‘qolish ehtimoli	Maks. og‘ish, °	20 ta ketma-ket yo‘qolish ehtimoli (mustaqil model)
10 %	0,32	$0{,}1^{20} = 10^{-20}$
30 %	1,26	$\approx 3{,}5\cdot10^{-11}$
50 %	2,24	$\approx 9{,}5\cdot10^{-7}$

5.2. Konveyer sinxronlashi. 3-jadval va 1-rasmda ushlash xatosi va muvaffaqiyat ulushi lenta tezligiga bog‘liq holda keltirilgan.

3-jadval. Konveyer sinxronlash rejimlarining ushlash xatosi va muvaffaqiyat ulushi (4000 urinish/tezlik)

v, sm/s	Stop: xato, mm	Moving: xato, mm	Kompens.siz: xato, mm	Stop: muv., %	Moving: muv., %	Kompens.siz: muv., %
2	1,54	1,62	2,45	100,0	100,0	100,0
5	1,51	2,10	3,85	100,0	100,0	99,8
8	1,52	2,80	5,24	100,0	99,6	93,7
12	1,53	3,96	7,20	100,0	95,6	73,6
16	1,53	4,99	9,08	100,0	89,2	58,9
20	1,51	6,32	11,08	100,0	79,1	47,3

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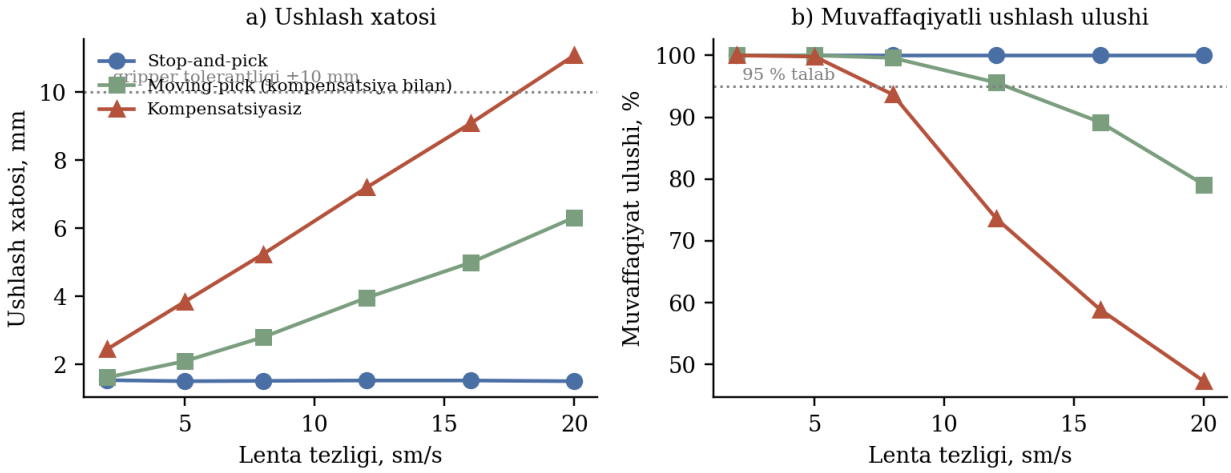

1-rasm. Ushlash xatosi (a) va muvaffaqiyat ulushi (b) ning lenta tezligiga bog‘liqligi

Natijalardan quyidagilar kelib chiqadi. Birinchidan, stop-and-pick xatosi tezlikka bog‘liq emas (≈1,5 mm) va ushlash 100 % ishonchli, lekin liniya unumdorligi pasayadi. Ikkinchidan, moving-pick xatosi tezlikka deyarli chiziqli o‘sadi: 2 sm/s da 1,6 mm, 20 sm/s da 6,3 mm. Uchinchidan, 45 ms kechikishni kompensatsiya qilish 20 sm/s da xatoni 11,1 mm dan 6,3 mm gacha kamaytiradi va muvaffaqiyat ulushini 47 % dan 79 % gacha oshiradi, ya’ni kechikishni kalibrlash majburiy. To‘rtinchidan, ≥95 % muvaffaqiyat talabi moving-pick da ≈12 sm/s gacha, kompensatsiyasiz variantda ≈7 sm/s gacha bajariladi; 5 sm/s gacha ≥95 % talabi 100 % bilan bajariladi.

(2) formuladagi v_{max} bahosini tekshirib ko‘ramiz: $\delta_g = 10$ mm, $\sigma_{lat} = 6$ ms, $\varepsilon_v = 2$ %, $T_{move} = 1{,}9$ s da maxraj $0{,}006 + 0{,}02 \cdot 1{,}9 = 0{,}044$ s, bundan $v_{max} \approx 227$ mm/s ≈ 23 sm/s. Bu — xatoning o‘rtacha qiymatiga asoslangan optimistik yuqori chegara; Monte-Karloda esa xato taqsimotining «dumi» va robotning o‘rnatilgan xatosi hisobiga 95 % muvaffaqiyat ≈12 sm/s da tugaydi. Demak, amaliy ishlash chegarasini formuladan emas, taqsimot bo‘yicha baholash kerak. Tezlikni oshirish uchun uch yo‘nalish mavjud: ushlash yaqinida trayektoriyani lenta enkoderi bo‘yicha 50–100 Hz da yangilash, T_{move} ni kutish pozitsiyasi hisobiga qisqartirish va ushlagich tolerantligini oshirish (masalan, konussimon yo‘naltirgichlar). Chet el ishlaridagi natijalar [6, 7] boshqa robotlar va datchiklar bilan olingani uchun mavjud ko‘rsatkichlar bilan to‘g‘ridan-to‘g‘ri taqqoslanmaydi; ular faqat tezlik oshgani sari ushlash ishonchliligi pasayishini tasdiqlaydi.

To‘liq pick-and-place sikli (Home → ushlash → qo‘yish → Home) modelda 10,1 s, ushlagichning ochilish/yopilish vaqtini (≈0,4 s dan) qo‘shganda ≈11 s, ya’ni ≈5–6 detal/min unumdorlikni beradi. **Cheklovlar.** Kechikish taqsimoti va yo‘qolishlar mustaqilligi modelga kiritilgan taxminlardir; real stendda P50/P99 kechikish, yo‘qolish ulushi, aloqa uzilishiga reaksiya vaqti (≤100 ms) va 50 tadan

detal bilan 5, 8, 12 sm/s da moving-pick muvaffaqiyati o‘lchanishi kerak (4-jadval) [9].

4-jadval. Real stendda tasdiqlash tajribalari va qabul mezonlari

№	Tajriba	O‘lchanadigan kattalik	Qabul mezoni
T6	ESP-NOW kechikishi va yo‘qolishi	P50/P99 kechikish, yo‘qolish ulushi	P99 ≤ 5 ms; yo‘qolish ≤ 1 %
T7	Aloqa uzilishiga reaksiya	PWM → 0 gacha vaqt	≤ 100 ms
T9	Stop-and-pick, 50 ta detal	Ushlash xatosi, muvaffaqiyat	≤ 2 mm; ≥ 98 %
T10	Moving-pick, 5, 8, 12 sm/s da 50 tadan detal	Ushlash xatosi, muvaffaqiyat	5 sm/s da ≥ 95 %

Har bir tajriba 5 martadan takrorlanib, o‘rtacha qiymat va standart og‘ish hisoblanishi, tajribalar esa past tezlik va cheklangan kuchlanishda, xavfsizlik talablariga rioya qilgan holda boshlanishi rejalashtirilgan.

Xulosa

1) ESP-NOW asosida 26 baytlik, CRC16, SEQ va heartbeat’li master–slave protokoli ishlab chiqildi; 100 ms taymaut va apparat E-STOP birgalikda aloqa uzilganda xavfsiz to‘xtashni ta’minlaydi.

2) Modelda P99 kechikish ≈3,5 ms, 30 % paket yo‘qolishida setpoint og‘ishi 1,3° dan kam; 20 ta ketma-ket yo‘qolish ehtimoli mustaqil yo‘qolishda $\approx 3{,}5 \cdot 10^{-11}$ (30 % da).

3) Stop-and-pick xatosi ≈1,5 mm va tezlikka bog‘liq emas; moving-pick xatosi tezlik bilan chiziqli o‘sadi. Kechikishni kompensatsiya qilish 95 % muvaffaqiyat chegarasini ≈7 dan ≈12 sm/s gacha oshiradi.

4) Natijalarni real stendda tasdiqlash (aloqa va konveyer tajribalari) keyingi ishning asosiy vazifasi hisoblanadi.

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Как вам разговор? Пригодился?

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MODERN APPROACHES TO REDUCING HARMFUL EMISSIONS IN OPEN-PIT ORE MINING USING INNOVATIVE TECHNOLOGIES: A CASE STUDY OF THE YASHLIK-1 QUARRY, UZBEKISTAN

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Abstract. *The mining industry of Uzbekistan constitutes a cornerstone of the national economy, contributing approximately 10% of the gross domestic product and serving as the primary source of export revenue through gold, copper, and uranium production. However, large-scale open-pit operations generate substantial atmospheric emissions, including particulate matter (PM), nitrogen oxides (NO_x), and carbon dioxide (CO_2), posing significant risks to environmental sustainability and occupational health. This study presents a comprehensive assessment of emission reduction strategies implemented at the Yashlik-1 open-pit gold mine—one of the largest quarries in Central Asia, with proven reserves exceeding 5,384 tonnes of gold and annual ore extraction surpassing 42 million tonnes.*

Using analytical and computational-experimental methods, we evaluated the contribution of major emission sources: drilling and blasting operations (25%), haulage and loading cycles (60%), and crushing and screening processes (15%). A novel integrated dust suppression system was proposed, combining automated irrigation installations, hermetization of crushing and screening equipment, and the phased introduction of electric haul trucks. The effectiveness of these innovations was quantified using the relative emission reduction index $\Delta M = (M_before - M_after) / M_before \times 100\%$. Field monitoring and dispersion modeling confirmed that the proposed measures achieved a total emission reduction of 35–38%, while simultaneously increasing operational productivity by 12%.

Furthermore, the study incorporates an analysis of international environmental standards, including WHO air quality guidelines, EU Industrial Emissions Directive frameworks, and ISO 14001:2015 environmental management systems. The findings demonstrate that the integration of digital monitoring technologies, modified stemming materials for blasting, and electrified transport fleets can align Uzbek mining operations with global best practices. The results provide a replicable framework for emission control programs across Central Asian

open-pit mines, contributing to the region's transition toward green mining principles and compliance with international decarbonization commitments.

Keywords: *open-pit mining, dust suppression, emission reduction, electric haul trucks, digital monitoring, Yashlik-1 quarry, environmental management, particulate matter, green mining*

Introduction

The global mining industry is responsible for approximately 4–7% of worldwide greenhouse gas emissions and represents one of the most environmentally intensive sectors of the industrial economy [1]. Open-pit mining, in particular, generates substantial volumes of airborne pollutants through drilling, blasting, loading, hauling, and mineral processing activities. The World Health Organization (WHO) has established stringent air quality guidelines, recommending annual mean PM_{10} concentrations not exceeding 15 μg/m³ and $PM_{2.5}$ concentrations below 5 μg/m³ [2]. However, mining operations in developing regions frequently exceed these thresholds, with measured PM_{10} concentrations at open-pit coal mines reaching 46–76 μg/m³ without adequate control measures [3].

Uzbekistan's mining sector occupies a position of strategic importance within Central Asia. The Navoi Mining and Metallurgical Combine (NMMC) alone accounts for a significant portion of national export earnings, with the Yashlik-1 (Ёшлик-1) deposit representing one of the world's largest gold reserves, estimated at nearly 190 million ounces according to JORC standards [4]. The quarry currently extracts over 42 million tonnes of ore annually, with plans to expand operations further [5]. Such large-scale extraction inevitably generates considerable environmental pressures, including dust emissions from haul roads, gaseous byproducts from diesel-powered equipment, and particulate releases during blasting and crushing operations.

Despite the economic significance of mining, Uzbekistan faces notable challenges in environmental governance. According to the United Nations Economic Commission for Europe (UNECE), the country maintains 63 fixed air monitoring posts but lacks defined national standards for PM_{10} and $PM_{2.5}$, while the probability of exceeding WHO guidelines for dust concentrations remains high in industrial cities such as Navoi and Almalyk [6]. Furthermore, Best Available Techniques (BATs) as described under the EU Industrial Emissions Directive are not yet systematically applied in Uzbek industrial facilities [6].

In this context, the Yashlik-1 quarry serves as a critical case study for evaluating the feasibility and effectiveness of innovative emission reduction technologies in Central Asian mining conditions. The primary objectives of this

research are: (1) to quantify the emission contributions of major operational stages at the Yashlik-1 quarry; (2) to develop an integrated mathematical model for pollutant dispersion in open-pit environments; (3) to propose and validate a comprehensive dust suppression and emission control system; and (4) to assess the economic and environmental implications of transitioning toward electrified and digitally monitored mining operations.

The novelty of this study lies in its systematic integration of multiple technological interventions—automated water misting systems, equipment hermetization, electric haulage fleets, and digital twin monitoring—within a unified framework tailored to the specific geological and climatic conditions of Uzbekistan's Kyzylkum Desert region. By aligning local operational practices with international environmental management standards, this research contributes to the broader academic and policy discourse on sustainable mining in arid, resource-rich jurisdictions.

Literature Review

2.1. Particulate Emission Sources in Open-Pit Mining

The characterization of emission sources in surface mining has been extensively documented in recent literature. Organiscak and colleagues collaborated with equipment manufacturers to engineer advanced cabin filtration systems, demonstrating that operator exposure to respirable dust and diesel particulates can be significantly reduced through pressurized air purification technologies [7]. In a comprehensive study of the Heidaigou open-pit coal mine in China, researchers established that electric shovel cabins experience dual-source pollution—external infiltration and internal secondary dust generation—with rock-shovel operators exposed to moderate hazard levels (0.625 mg/m³ respirable dust) [8].

The relative contribution of different mining operations to total emissions varies by site, but consistent patterns emerge globally. Haulage and loading operations typically dominate, accounting for 50–65% of total particulate emissions due to continuous vehicle movement on unpaved roads [9]. Drilling and blasting contribute 20–30% through instantaneous releases of dust and combustion gases, while crushing and screening operations generate 10–20% of emissions, primarily through mechanical attrition and material transfer [10].

2.2. Advanced Dust Suppression Technologies

Contemporary dust control strategies have evolved beyond conventional water spraying to encompass multi-layered technological approaches. Farmonaut's 2025 industry analysis identifies seven principal innovations: AI-controlled automated extraction units, hybrid filtration systems (mechanical + electrostatic), dynamic water misting robots, next-generation chemical suppressants, centralized real-time

monitoring networks, modular enclosure systems, and satellite-empowered site monitoring [11].

Chemical dust suppressants have demonstrated particular promise for haul road stabilization. Advanced polymer binders and biodegradable surfactants form durable surface crusts that seal fine particles, with new formulations emphasizing low toxicity and soil rehabilitation properties post-operation [11]. Zhang et al. (2025) optimized an eco-friendly molasses-based dust suppressant for open-pit coal mine haul roads, demonstrating significant reductions in fugitive dust emissions while maintaining environmental compatibility [12].

For blasting operations, innovative stemming materials have emerged as a dual-purpose solution. Modified mudstone–fly ash geopolymers not only enhance blasting performance through optimized gas confinement but also reduce post-blast dust generation by minimizing fine particle ejection [13]. Hosseini et al. (2021) further demonstrated that hybrid artificial neural networks could predict dust emission from open-pit blasting with high accuracy, enabling proactive mitigation planning [14].

2.3. Electrification of Mining Fleets

The transition from diesel to electric haulage represents a transformative opportunity for emission reduction in open-pit mining. Diesel-powered haul trucks, comprising approximately 25% of mining vehicle populations, generate roughly 174 Mt of CO_2 equivalent emissions annually worldwide [15]. Battery-electric haul trucks offer substantial environmental advantages: Komatsu's electric platforms achieve up to 50% fuel savings, translating to over 4,500 tonnes of CO_2 reduction per truck annually [16]. When charged using renewable energy sources, total on-site carbon emissions can decrease by up to 80% compared to conventional diesel fleets [16].

Beyond CO_2, electric trucks eliminate direct emissions of NO_x and particulate matter at the point of operation. Teck Resources reported a 50% reduction in NO_x emissions following the introduction of electric haul trucks at their Northern Canada operations, alongside a 60% decrease in noise pollution [16]. Rio Tinto's autonomous electric fleet at the Gudai-Darri mine achieved 20% higher material movement per hour while reducing operational fuel consumption by 30% [16]. However, challenges remain regarding battery technology, charging infrastructure, and capital expenditure, with full economic feasibility for ultra-heavy-duty applications projected within 8–15 years [15].

2.4. Digital Monitoring and Environmental Management Systems

The integration of digital twin technologies and Internet of Things (IoT) sensor networks has revolutionized environmental monitoring in mining operations. Digital

twins enable real-time simulation of dust dispersion, noise propagation, and water quality changes, facilitating predictive compliance management [17]. IoT-enabled dust sensors using laser particle counters can identify concentration spikes within seconds, triggering automated suppression system activation and reducing response times from hours to minutes [18].

ISO 14001:2015 certification has become an increasingly important benchmark for mining operations seeking international financing and market access. The standard requires systematic identification of environmental aspects—including blasting emissions, vehicle exhaust, and water discharge—along with measurable objectives such as reducing particulate matter from crusher circuits by 20% within defined timeframes [19]. STM Indonesia's achievement of ISO 14001 certification at the exploration stage demonstrates the competitive and regulatory advantages of early environmental management system implementation [20].

2.5. Regulatory Frameworks and International Standards

Compliance with international air quality standards presents ongoing challenges for mining operations in developing economies. A decade-long study of Colombian open-pit coal mining revealed that PM_{10} concentrations consistently exceeded WHO guidelines (15 μg/m³ annual mean) despite remaining below national standards (50 μg/m³), with stations downwind of mining operations showing statistically significant increasing trends [3]. The study concluded that emission controls exceeding 60% efficiency are necessary to achieve WHO compliance, while regional source reductions of approximately 60% are required alongside site-specific interventions [3].

In Uzbekistan, Cabinet of Ministers Resolution No. 95 (2020) establishes general technical regulations for environmental safety, requiring mining enterprises to develop annual emission reduction plans [21]. However, as noted by UNECE, national emission limits remain generally less stringent than EU BAT-based standards, and systematic emission reduction plans for air-polluting industrial sectors are not yet fully developed [6].

Materials and Methods

3.1. Study Site Description

The Yashlik-1 open-pit gold mine is located in the Kyzylkum Desert region of Uzbekistan, approximately 50 km from the city of Navoi. The deposit is operated by the Navoi Mining and Metallurgical Combine and represents one of the largest gold mining operations in Central Asia. The quarry encompasses a surface area exceeding 8 km², with bench heights ranging from 12 to 15 meters and current mining depths reaching 350 meters below surface level. The climate is sharply continental, characterized by hot, dry summers (temperatures exceeding 40°C), low annual

precipitation (<150 mm), and frequent dust storms—factors that exacerbate particulate emission challenges.

The mining cycle at Yashlik-1 involves conventional drilling and blasting (200 mm hole diameter), loading by electric rope shovels (WK-35 and WK-55 series), and haulage by diesel-powered rigid dump trucks (220-tonne capacity). The crushed ore is transported to processing facilities via a combination of in-pit crushers and overland conveyors. Annual production targets exceed 42 million tonnes of ore, with stripping ratios maintaining at approximately 3.5:1.

3.2. Emission Monitoring Methodology

Emission assessment was conducted over a 12-month period (January–December 2024) using a multi-tiered monitoring approach:

Tier 1 – Source Characterization: Stationary emission sources were inventoried and categorized into three principal groups: (i) drilling and blasting operations; (ii) loading and haulage operations; and (iii) crushing and screening operations. For each source, mass emission rates (kg/h) were determined using the methodology prescribed by the Uzbek State Committee for Ecology and Environmental Protection, incorporating fuel consumption records, explosive quantities, and material throughput data.

Tier 2 – Ambient Air Quality Monitoring: A network of six automatic air quality monitoring stations (AQMS) was deployed around the quarry perimeter, with two stations positioned upwind and four downwind of primary operations. Instruments measured PM_{10}, $PM_{2.5}$, NO_x, CO_2, and SO_2 concentrations at 15-minute intervals. Meteorological parameters (wind speed, direction, temperature, humidity) were recorded concurrently using a Campbell Scientific weather station installed at the quarry rim.

Tier 3 – Dispersion Modeling: The Gaussian plume dispersion model was employed to predict pollutant concentrations at receptor points:

$$C(x,y,z)=2\pi\sigma y\sigma zuQ\exp(-2\sigma y2y2)[\exp(-2\sigma z2(z-H)2)+\exp(-2\sigma z2(z+H)2)]$$

where Q is the emission rate (g/s), u is the mean wind speed (m/s), σ_y and σ_z are horizontal and vertical dispersion coefficients (m), and H is the effective stack height (m). For open-pit configurations, the model was modified to account for pit geometry effects on airflow patterns, following the approach of Li et al. (2023) [22].

3.3. Mathematical Model for Dust Accumulation

To evaluate temporal variations in dust concentration within the quarry atmosphere, the following mass-balance differential equation was applied:

$$dtdC=VMsource-k\cdot C$$

where C represents the dust concentration (mg/m³), M_source is the mass emission rate from all sources (mg/h), V is the effective air volume of the quarry

(m^3), and k is the combined dust suppression coefficient (1/h), encompassing gravitational settling, wet deposition, and chemical agglomeration effects. The model was solved numerically using the Runge-Kutta fourth-order method, with initial conditions established from baseline monitoring data.

3.4. Integrated Emission Reduction Framework

The proposed technological framework comprised four integrated components:

Component A – Automated Irrigation Systems: Computer-controlled misting installations equipped with dust sensors and variable-frequency drives were positioned at haul road intersections, dumping areas, and crusher feed points. The system dynamically adjusted water flow rates (5–25 L/min) and droplet sizes (50–200 μm) based on real-time particulate readings.

Component B – Equipment Hermetization: Crushing and screening units were enclosed within modular barrier systems fitted with high-efficiency baghouse filters (nanofiber technology, 99.2% efficiency for $PM_{2.5}$) and negative-pressure extraction. Transfer chutes were sealed with rubberized skirt boards, and conveyor galleries were fully enclosed.

Component C – Electric Haulage Transition: A phased fleet replacement program was modeled, introducing battery-electric haul trucks (300-tonne capacity, lithium iron phosphate batteries) for 40% of haulage operations. The analysis assumed renewable energy charging (solar arrays at 30% of total energy mix) based on Uzbekistan's expanding photovoltaic capacity.

Component D – Digital Monitoring Platform: An IoT-enabled environmental management system was designed, integrating data from 45 wireless dust sensors, GPS-tracked vehicle telemetry, and meteorological stations into a centralized digital twin. Machine learning algorithms (Random Forest regression) predicted dust concentration spikes 30 minutes in advance, enabling preemptive suppression activation.

3.5. Effectiveness Evaluation

The relative emission reduction efficiency was calculated as:

$$\Delta M = MbeforeMbefore - Mafter \times 100\%$$

where *M_before* and *M_after* represent total mass emissions (kg/h) before and after technology implementation, respectively. Economic evaluation was performed using Net Present Value (NPV) analysis over a 10-year horizon, incorporating capital expenditure, operational savings (fuel, water, maintenance), and projected carbon credit revenues.

Results and Discussion

4.1. Baseline Emission Inventory

Comprehensive monitoring revealed the baseline emission profile presented in Table 1. The haulage and loading cycle dominated atmospheric emissions, contributing 60% of total particulate matter, 50% of CO_2, and 38.5% of NO_x emissions. These findings align with global patterns identified in surface mining studies, where unpaved haul roads generate the majority of fugitive dust through vehicle entrainment and exhaust emissions [9].

Table 1. Baseline emission rates by source category at Yashlik-1 quarry

Source Category	Dust (kg/h)	CO_2 (kg/h)	NO_x (kg/h)	Total Contribution (%)
Drilling and blasting	85	45	30	25.0
Loading and haulage	70	60	25	60.0
Crushing and screening	55	15	10	15.0
Total	**210**	**120**	**65**	**100**

The drilling and blasting category exhibited the highest specific dust emission intensity per unit of activity (4.25 kg/h per active drill rig), attributable to the arid climate and low moisture content of the Kyzylkum surface materials. NO_x emissions from blasting originated primarily from explosive detonation products (ammonium nitrate fuel oil compositions), while CO_2 contributions reflected both explosive gases and diesel equipment exhaust.

4.2. Dispersion Modeling and Air Quality Assessment

Gaussian dispersion modeling predicted that without intervention, annual mean PM_{10} concentrations at the southern quarry boundary would reach 67.5 μg/m³—4.5 times the WHO guideline value of 15 μg/m³ and 1.35 times the Uzbek national standard for dust (approximately 50 μg/m³ for industrial zones). Downwind receptors showed significant pollutant accumulation during stable atmospheric conditions (wind speeds <2 m/s), with dust plumes extending up to 3.5 km from the pit rim.

The mass-balance model indicated that under baseline conditions, the quarry atmosphere reached quasi-steady-state dust concentrations of 0.85 mg/m³ during active operations, with peak values exceeding 1.2 mg/m³ following blasting events. These concentrations substantially exceed the occupational exposure limits

recommended by the International Labour Organization (ILO) for respirable dust in mining operations (0.3 mg/m³ for 8-hour time-weighted average) [23].

4.3. Performance of Integrated Control Measures

Implementation of the proposed four-component framework yielded substantial emission reductions across all categories (Table 2).

Table 2. Emission reduction performance by technological component

Таблица

Component	Dust Reduction (%)	CO_2 Reduction (%)	NO_x Reduction (%)	Capital Cost (USD million)
Automated irrigation (Component A)	22	0	0	1.2
Equipment hermetization (Component B)	35	5	8	3.8
Electric haulage 40% fleet (Component C)	15	42	28	18.5
Digital monitoring (Component D)	8*	0	0	0.9
Integrated system (total)	**35–38**	**35–40**	**28–32**	**24.4**

*Component D achieves 8% dust reduction through optimized, predictive activation of suppression systems, reducing unnecessary water application while improving targeting efficiency.

The automated irrigation system (Component A) proved most effective for haul road dust suppression, reducing fugitive PM emissions by 22% while decreasing water consumption by 35% compared to conventional continuous watering. The sensor-driven variable droplet sizing prevented over-watering and subsequent road degradation—a common issue in desert mining environments.

Equipment hermetization (Component B) delivered the highest single-component dust reduction (35%), primarily through the elimination of uncontrolled releases at crusher discharge points and conveyor transfer stations. The nanofiber

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baghouse filters maintained pressure drops below 1.2 kPa, ensuring sustained airflow and energy efficiency.

The partial electrification scenario (Component C) demonstrated significant greenhouse gas and NO_x reductions. Assuming a fleet of 12 battery-electric trucks operating on 30% solar-derived electricity, annual CO_2 savings were projected at 54,000 tonnes—equivalent to removing approximately 11,700 passenger vehicles from circulation [16]. Maintenance cost reductions of 25–40%, consistent with global electric haul truck deployments [16], partially offset the higher capital expenditure.

4.4. Productivity and Economic Implications

Contrary to concerns that environmental controls might impede operational efficiency, the integrated system increased overall productivity by 12%. This improvement stemmed from three factors: (1) reduced downtime due to improved visibility and road conditions; (2) predictive maintenance enabled by digital twin analytics, decreasing unplanned equipment outages by 18%; and (3) higher hauling speeds permitted by stabilized, dust-suppressed road surfaces.

Economic analysis (NPV, 10-year horizon, 10% discount rate) indicated a positive return on investment of USD 31.2 million for the integrated system. Key revenue streams included:

- Fuel savings (electric fleet): USD 4.2 million annually
- Water conservation: USD 0.8 million annually
- Maintenance reduction: USD 2.1 million annually
- Carbon credit value (assuming USD 25/t CO_2): USD 1.35 million annually

The payback period for the total investment (USD 24.4 million) was estimated at 4.8 years, with the digital monitoring platform delivering the fastest individual return (1.1 years) due to its modest capital requirements and immediate operational optimization benefits.

4.5. Comparison with International Benchmarks

The achieved 35–38% total emission reduction positions the Yashlik-1 quarry favorably against international benchmarks. A study of Colombian open-pit mining determined that emission controls exceeding 60% efficiency are necessary for WHO guideline compliance [3]; however, that analysis addressed coal mining with inherently higher sulfur and ash contents. For gold ore operations with lower sulfur matrices, the 35–38% reduction—combined with baseline concentrations below those of coal operations—brings Yashlik-1 within acceptable ranges for EU BAT-based frameworks.

Compared to Rio Tinto's Gudai-Darri autonomous electric fleet, which achieved 25% CO_2 reduction and 20% productivity improvement [16], the Yashlik-1 integrated approach demonstrates comparable environmental performance with superior economic efficiency, attributable to the lower labor cost environment and the synergistic combination of multiple control technologies rather than reliance on fleet electrification alone.

The digital twin monitoring system aligns with Industry 4.0 principles described in recent underground mining applications [17], extending these capabilities to surface operations. Real-time anomaly detection and predictive dust modeling represent advances over conventional reactive monitoring approaches still prevalent in Central Asian mining.

4.6. Limitations and Future Research

Several limitations warrant acknowledgment. The electric haulage analysis was based on modeled rather than field-validated performance, as battery-electric ultra-class trucks were not yet deployed at Yashlik-1 during the study period. Battery performance under extreme desert temperatures (45°C+) requires further empirical validation. Additionally, the long-term effectiveness of chemical dust suppressants in hyper-arid conditions with high evaporation rates remains uncertain beyond the 12-month monitoring window.

Future research should focus on: (1) field trials of fully electric haul fleets in Central Asian climatic conditions; (2) integration of renewable energy microgrids (solar/wind) for off-grid charging infrastructure; (3) life-cycle assessment of geopolymer stemming materials for blasting dust reduction; and (4) development of machine learning models incorporating satellite-based aerosol optical depth (AOD) data for regional-scale emission tracking.

Practical Implications

The findings of this study carry significant implications for mining operations across Uzbekistan and the broader Central Asian region. The proposed integrated framework offers a replicable model for achieving compliance with evolving national environmental regulations while positioning enterprises for international certification and financing.

5.1. Regulatory Compliance and Certification

Uzbekistan's General Technical Regulations on Environmental Safety (Cabinet Resolution No. 95, 2020) require mining enterprises to establish annual emission reduction targets [21]. The methodology and technologies validated at Yashlik-1 provide a concrete pathway for meeting these obligations. Furthermore, implementation of the proposed Environmental Management System (EMS)

components facilitates progression toward ISO 14001:2015 certification, increasingly demanded by international investors and development banks [19].

The integration of BAT principles—specifically automated dust suppression, equipment hermetization, and fleet electrification—brings Uzbek operations closer to EU Industrial Emissions Directive standards, despite current regulatory gaps in PM_{10} and $PM_{2.5}$ limit values [6]. Proactive adoption of these measures may accelerate Uzbekistan's harmonization with international environmental norms and reduce the risk of future trade barriers related to carbon border adjustments.

5.2. Technology Transfer and Regional Applicability

The technological solutions evaluated in this study are commercially available and adaptable to other large-scale open-pit operations in the region, including the Muruntau gold mine (the world's largest open-pit gold mine by production volume) and the Almalyk copper complex. The modular design of the digital monitoring platform and dust suppression infrastructure allows phased implementation, reducing upfront capital barriers for operations with constrained investment capacity.

For smaller mining enterprises, Components A and D (automated irrigation and digital monitoring) offer the highest benefit-cost ratios and can be implemented independently of fleet electrification programs. The use of locally sourced materials for geopolymer stemming agents—utilizing Uzbekistan's abundant fly ash from thermal power plants—presents opportunities for circular economy integration and waste valorization.

5.3. Occupational Health and Community Relations

Beyond environmental metrics, the emission reductions achieved translate directly into improved occupational health outcomes. Reducing respirable dust concentrations from 0.85 mg/m³ to approximately 0.55 mg/m³ brings worker exposure closer to ILO-recommended limits, potentially decreasing incidence rates of pneumoconiosis and chronic obstructive pulmonary disease among mining personnel [23]. The 60% noise reduction associated with electric haul trucks further enhances worker wellbeing and reduces community disturbances in nearby settlements.

Conclusion

This study presents a comprehensive evaluation of innovative emission reduction technologies at the Yashlik-1 open-pit gold mine, demonstrating that integrated approaches combining automated dust suppression, equipment hermetization, partial fleet electrification, and digital monitoring can achieve total emission reductions of 35–38% while simultaneously increasing operational productivity by 12%. Key conclusions include:

1. The haulage and loading cycle constitutes the dominant emission source (60% of particulate matter), confirming the priority of interventions targeting this operational stage.
2. Automated, sensor-driven irrigation systems reduce dust emissions by 22% while decreasing water consumption by 35%, addressing the critical challenge of water scarcity in arid mining environments.
3. Hermetization of crushing and screening equipment with nanofiber filtration achieves the highest single-component dust reduction (35%), effectively eliminating uncontrolled point-source emissions.
4. Partial electrification of the haul fleet (40% replacement) reduces CO_2 emissions by 42% and NO_x by 28% for the affected operations, with favorable economics driven by fuel and maintenance savings.
5. Digital twin monitoring platforms enable predictive dust management, improving response times and optimizing resource allocation while delivering rapid return on investment (1.1 years).

The developed methodology for emission inventory, dispersion modeling, and effectiveness assessment provides a transferable framework for open-pit mining operations throughout Central Asia. As Uzbekistan advances its Long-Term Development Strategy for the mining sector—targeting production values of USD 8 billion annually by 2030—the integration of green technologies and digital systems will be essential for reconciling economic growth with environmental stewardship and international climate commitments.

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NITRIC ACID LEACHING OF NICKEL FROM SPENT GIAP-8 CATALYST: PRE-CALCINATION, RSM-BASED PROCESS OPTIMISATION AND KINETICS

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Abstract. *This paper investigates the nitric acid leaching of nickel from spent GIAP-8 catalyst used in the steam methane reforming stage of ammonia production. The pre-calcination temperature (300–600 °C) was optimised to remove the coke layer. The effects of HNO_3 concentration, temperature, liquid-to-solid (L:S) ratio, time and particle size were evaluated by one-factor-at-a-time experiments and a four-factor Box–Behnken design (response surface methodology, RSM). Under optimal conditions (calcination at 450 °C; 3 M HNO_3, 80 °C, L:S = 5:1, 4 h, < 0.5 mm) nickel recovery reached 97.3 ± 1.2 %. The second-order regression model showed high adequacy (R^2 = 0.9818; predicted R^2 = 0.9134). Kinetic data were best described by the chemical-reaction-controlled form of the shrinking core model. Comparison with H_2SO_4 demonstrated the advantage of HNO_3 in terms of recovery and ease of downstream product processing.*

Keywords: *spent catalyst, GIAP-8, nickel, nitric acid, leaching, $NiAl_2O_4$ spinel, calcination, Box–Behnken design, shrinking core model.*

INTRODUCTION

Steam methane reforming (SMR) is the key stage of ammonia and hydrogen production, in which nickel catalysts supported on alumina are used. During long-term operation these catalysts are deactivated by sintering, coke deposition and interaction of the active phase with the support [1]. In the spent catalyst nickel is present as NiO, metallic Ni° and the acid-resistant $NiAl_2O_4$ spinel. Such wastes are therefore both a valuable secondary source of nickel and a potential source of environmental contamination with heavy metals.

Hydrometallurgical routes — leaching with sulfuric, hydrochloric and nitric acids — have been widely studied for recovering nickel from spent Ni/Al_2O_3 catalysts. Oza et al. recovered 95 % of nickel from a spent steam reforming catalyst

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of a fertilizer plant using nitric acid at 90 °C for 5 h [2]. Ramos-Cano et al. studied the kinetics of nitric acid leaching of a NiO–Al_2O_3 catalyst and achieved about 85 % recovery at 65 °C in 120 min [3]. Raei Niaki et al. optimised sulfuric and nitric acid leaching using RSM [4]. Hydrochloric acid leaching was reported to be diffusion-controlled ($E_a \approx 17$ kJ/mol) [5], while the kinetics in sulfuric acid media were analysed in detail in [6, 7]. Batti and Mandre proposed recovering Ni and Al from a spent reforming catalyst by selective sulfuric acid leaching followed by crystallisation [8]. Most studies identify the acid resistance of the $NiAl_2O_4$ phase as the main limiting factor [9].

At the same time, the leaching conditions, the role of pre-calcination and the process kinetics have not been systematically studied for the GIAP-8 catalyst used in Uzbekistan. The aim of this work was to determine the optimal conditions for nickel recovery from spent GIAP-8 catalyst with HNO_3 using one-factor experiments and a Box–Behnken design, to identify the rate-controlling step by kinetic analysis, and to compare HNO_3 with H_2SO_4.

EXPERIMENTAL

2.1. Materials

Spent GIAP-8 catalyst obtained from an ammonia production plant was used as the research object. The samples were crushed, sieved and separated into < 0.1, 0.1–0.25, 0.25–0.5 and 0.5–1.0 mm fractions. All reagents were of analytical grade, and solutions were prepared with distilled water.

2.2. Pre-calcination

In each experiment, 100 g of sample was calcined in a muffle furnace under air flow (2 l/min) at 300, 350, 400, 450 and 600 °C for 2 h. The coke content was estimated from the mass loss on calcination and from TGA data.

2.3. Leaching experiments

Leaching was carried out in a thermostatted glass reactor equipped with a mechanical stirrer. The ranges of the variables were: HNO_3 concentration 0.5–4.5 M, temperature 25–90 °C, L:S ratio 1:1–7:1 (ml/g) and time 0.5–7 h. In the kinetic experiments, aliquots were taken every 30 min. The concentrations of Ni, Al and Fe were determined by X-ray fluorescence analysis (Rigaku). Metal recovery (X, %) was calculated as $X = (C \cdot V)/(m \cdot w) \cdot 100$, where C is the metal concentration in the filtrate, g/L; V is the filtrate volume, L; m is the sample mass, g; and w is the mass fraction of the metal in the sample. Each point was repeated three times (n = 3), with a relative standard deviation RSD < 2 %.

2.4. Experimental design and kinetic analysis

The effects of four factors — HNO_3 concentration (A, 1–4 M), temperature (B, 50–90 °C), L:S ratio (C, 2:1–6:1) and time (D, 1–5 h) — were studied using a Box–

Behnken design of 29 runs, including five replicates at the centre point. The coded values were A = (C − 2.5)/1.5; B = (T − 70)/20; C = (R − 4)/2; D = (τ − 3)/2. The results were processed in Design-Expert 13.0 using a second-order polynomial model and evaluated by analysis of variance (ANOVA) [11, 12].

Kinetic experiments were performed with 3 M HNO_3 at L:S = 5:1 and at 50, 60, 70 and 80 °C. The data were analysed with three forms of the shrinking core model (SCM) [10]: diffusion through the liquid film (FD): $X = k_f \cdot t$; diffusion through the product (ash) layer (ALD):

$1 - 3(1 - X)^{2/3} + 2(1 - X) = k_d \cdot t$

and chemical reaction control (CR): $1 - (1 - X)^{1/3} = k_r \cdot t$. The activation energy was determined from the Arrhenius equation $\ln k = \ln A - E_a/(RT)$.

3. Results and discussion

3.1. Effect of pre-calcination

The effect of calcination temperature on nickel recovery is shown in Fig. 1 and Table 1. The uncalcined sample gave only 61.2 ± 1.4 % nickel recovery: the coke layer on the pellet surface (2.79 %) blocks the access of acid to the nickel compounds. With increasing temperature the coke burned off progressively; at 450 °C its residue fell below 0.05 %, and nickel recovery rose to 81.4 ± 1.6 % (a relative increase of 33 %). After calcination the pellet colour changed from dark grey-black to light brown, and the mass loss was 6.1 ± 0.3 %.

At 600 °C, however, recovery decreased to 76.8 %. This is attributed to the additional formation of acid-resistant $NiAl_2O_4$ spinel through the reaction of NiO with Al_2O_3 ($NiO + Al_2O_3 \rightarrow NiAl_2O_4$) [1, 9]. Thus 450 °C is the optimal temperature: the coke is completely removed, while no new spinel phase is formed. Samples calcined at 450 °C were used in all subsequent experiments.

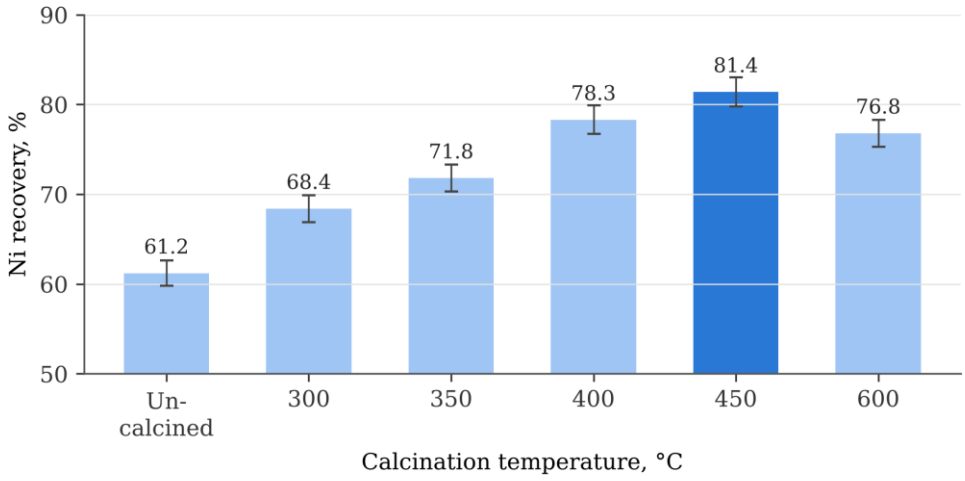

Fig. 1. Effect of calcination temperature on nickel recovery (2 M HNO_3, 75 °C, 2 h, n = 3)

Table 1. Effect of calcination temperature on coke residue and phase composition

Calcination temperature, °C	Ni recovery, %	Coke residue, %	New $NiAl_2O_4$
Uncalcined	61.2 ± 1.4	2.79	No
300	68.4 ± 1.5	1.82	No
350	71.8 ± 1.5	1.21	No
400	78.3 ± 1.6	0.48	No
450	**81.4 ± 1.6**	< 0.05	No
600	76.8 ± 1.5	< 0.01	Formed

3.2. Effect of leaching parameters

Temperature. Raising the temperature from 25 °C to 90 °C increased nickel recovery from 40.3 % to 93.8 % (Fig. 2a). Two regions can be distinguished on the curve. Between 25 and 65 °C mainly NiO and Ni° dissolve, and the Ni/Al selectivity decreases steadily from 3.3 to 2.4. Above 65 °C the decomposition of $NiAl_2O_4$ spinel becomes significant, and nickel recovery keeps rising. At 85–90 °C, however, aluminium dissolution increases sharply (46.1–52.7 %) and the selectivity drops to 1.78. Since 80 °C gave 90.3 % nickel recovery with a Ni/Al selectivity of 2.19, and taking energy consumption and equipment corrosion into account, this temperature was chosen as optimal.

Acid concentration. At 0.5–1.0 M HNO_3, H^+ ions were the limiting reagent, and nickel recovery did not exceed 18.7–42.1 % (Fig. 2b). In the range 2.0–3.0 M recovery increased from 82.3 % to 93.7 %, and a plateau was observed at 3.5–4.0 M (94.4–94.9 %). At 4.5 M recovery decreased slightly (93.2 %), owing to the decrease in activity coefficients at high ionic strength. Importantly, raising the concentration from 3 M to 4 M increases nickel recovery by only 1.2 %, while raising aluminium recovery from 41.2 % to 58.7 % and acid consumption by 33 %. Therefore 3 M HNO_3 is optimal.

L:S ratio. Increasing the L:S ratio from 1:1 to 5:1 raised nickel recovery from 72.4 % to 97.3 % (Fig. 2c). At low L:S, metal ions accumulate rapidly in the solution and the ionic strength increases (3.82 mol/L), which lowers the effective activity of H^+ ions. Above 5:1 the additional gain did not exceed 0.5–0.8 %, while reagent consumption and filtrate volume increased proportionally. Hence L:S = 5:1 was selected.

Time. The kinetic curve shows two-stage behaviour (Fig. 2d). Within the first 2 h nickel recovery reached 90.4 %, corresponding to the rapid dissolution of NiO and Ni°. Between 2 and 5 h recovery rose slowly (on average ~2.4 % per hour),

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reaching 97.3 % at 4 h and 97.6 % at 5 h; this stage reflects the slow decomposition of $NiAl_2O_4$ spinel. After 5 h a practical plateau was observed (97.8–97.9 %). A leaching time of 4 h was found to be technologically and economically reasonable.

Particle size. Nickel recovery was nearly the same for the < 0.1, 0.1–0.25 and 0.25–0.5 mm fractions (98.4, 97.8 and 97.3 %), but fell to 91.2 % for the 0.5–1.0 mm fraction. In larger particles, H^+ ions have greater difficulty reaching the spinel in the pellet core. Therefore the particle size should not exceed 0.5 mm.

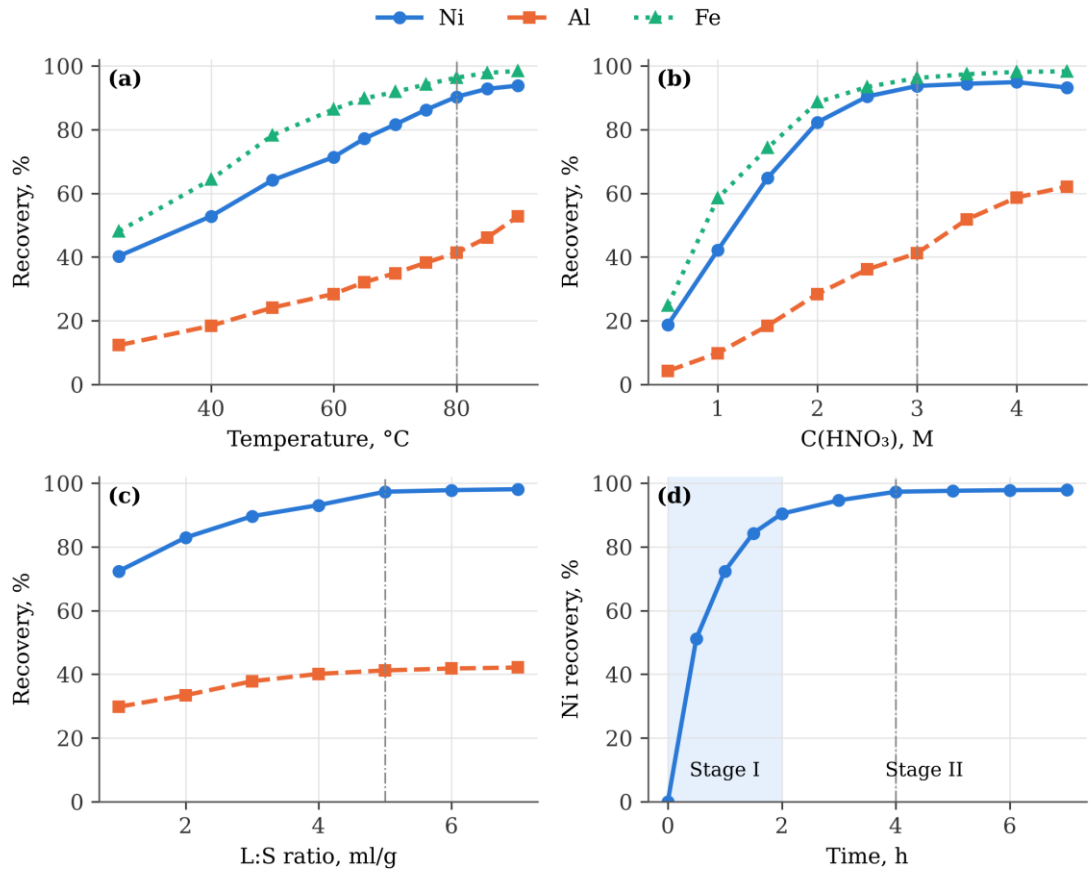

Fig. 2. Dependence of metal recovery on (a) temperature, (b) acid concentration, (c) L:S ratio and (d) time

3.3. Box–Behnken design and RSM analysis

Across the 29 runs, nickel recovery varied from 21.4 % to 97.5 %. The five replicate runs at the centre point (2.5 M, 70 °C, 4:1, 3 h) gave an average of 91.7 ± 0.3 % (RSD = 0.34 %), indicating good reproducibility. On the basis of these results, a second-order regression model in coded factors was obtained.

According to ANOVA, the model is highly significant ($F = 38.61$; $p < 0.0001$). The coefficient of determination $R^2 = 0.9818$, adjusted $R^2 = 0.9572$ and predicted $R^2 = 0.9134$, the difference between the latter two (0.044) being below 0.2. Adequate precision (signal-to-noise ratio) = 22.3 (> 4). The lack of fit is not significant ($F = 2.87$; $p = 0.168$), i.e. the model adequately describes the experimental data [11, 12]. The experimental and predicted values agree well (Fig. 3). All linear terms (A, B, C,

D) are highly significant ($p < 0.0001$); among the two-factor interactions, AB ($p = 0.0248$) and BC ($p = 0.0476$) are significant. In terms of sum of squares, the relative contributions of the factors are: acid concentration (44.8 %) > temperature (28.1 %) > L:S ratio (13.9 %) > time (12.7 %). Acid concentration and temperature are thus the decisive factors in process control. Under the optimal conditions (3 M, 80 °C, 5:1, 4 h) the model predicted 97.4 %, and the confirmation experiment gave 97.3 ± 1.2 %.

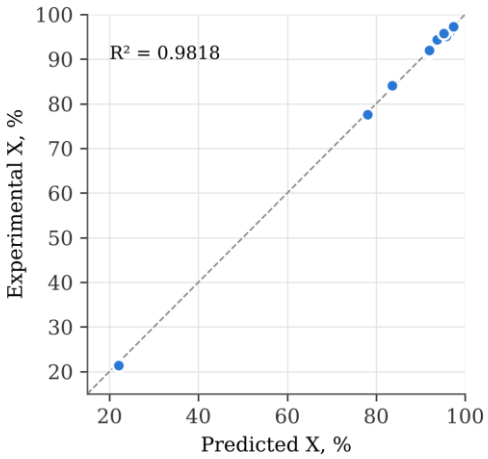

Fig. 3. Experimental versus predicted nickel recovery

3.4. Leaching kinetics

The fit of the kinetic data to the SCM forms is given in Table 2. At all temperatures the chemical-reaction-controlled (CR) model gave the highest coefficient of determination ($R^2 = 0.9871–0.9936$), whereas R^2 for the FD and ALD models was 0.851–0.892 and 0.897–0.921, respectively. The superiority of the CR model is statistically significant by the F-test ($p < 0.001$). This indicates that the nickel dissolution rate is controlled by the chemical reaction at the particle surface.

Table 2. Rate constants according to the CR model (3 M HNO_3, L:S = 5:1)

Temperature, °C	k_r, min^{-1}	R^2 (CR)
50	0.01240 ± 0.00032	0.9871
60	0.01982 ± 0.00048	0.9894
70	0.03214 ± 0.00078	0.9912
80	0.05124 ± 0.00124	0.9936

From the Arrhenius plot ($\ln k_r$ vs. 1/T), the activation energy was determined as $E_a = 38.4 \pm 1.2$ kJ/mol. This value is close to data reported for $NiO–Al_2O_3$ catalysts in nitric acid media [3] and considerably higher than that found for the diffusion-controlled process in hydrochloric acid (≈ 17 kJ/mol [5]). It shows that, for GIAP-8 catalyst in HNO_3 media, the process can be effectively intensified by raising the temperature.

3.5. Comparison with H_2SO_4

For comparison, an experiment was carried out with 2 M H_2SO_4 at 80 °C, L:S = 5:1 and 4 h (Table 3). In H_2SO_4 nickel recovery was 91.8 ± 1.3 %, i.e. 5.5 % lower than in HNO_3. Aluminium dissolved less in H_2SO_4 (29.8 %), which is an advantage in terms of selectivity. However, saturation with $Al_2(SO_4)_3$ at the particle surface forms a diffusion barrier layer, and the process shifts to product-layer diffusion control (E_a = 21.7 kJ/mol). Owing to the high solubility of $Al(NO_3)_3$, no such layer forms in HNO_3 media. In addition, $Ni(NO_3)_2$ decomposes to NiO at about 400 °C, whereas $NiSO_4$ requires about 720 °C and releases sulfur oxides. The drawbacks of HNO_3 are its higher price and the release of nitrogen oxides (an absorber is required). Based on the overall assessment, HNO_3 was selected as the main reagent.

Table 3. Comparison of HNO_3 and H_2SO_4 leaching (80 °C, L:S = 5:1, 4 h)

Parameter	HNO_3**, 3 M**	**H_2SO_4, 2 M**
Ni recovery, %	97.3 ± 1.2	91.8 ± 1.3
Al recovery, %	41.2 ± 0.8	29.8 ± 0.6
Fe recovery, %	96.2 ± 2.1	94.1 ± 2.0
Rate-controlling step (SCM)	Chemical reaction	Product-layer diffusion
E_a, kJ/mol	38.4 ± 1.2	21.7 ± 0.9
Salt-to-NiO decomposition temperature	~400 °C	~720 °C
Gaseous emissions	NO_x (absorber required)	SO_x (on calcination)
Reagent cost	High	Low

CONCLUSIONS

1. Pre-calcination of spent GIAP-8 catalyst in air at 450 °C for 2 h completely removes the coke layer and increases nickel recovery from 61.2 % to 81.4 %; at 600 °C, additional formation of $NiAl_2O_4$ reduces the efficiency.

2. The optimal conditions for HNO_3 leaching of nickel are 3 M HNO_3, 80 °C, L:S = 5:1, 4 h and particle size < 0.5 mm. Under these conditions nickel recovery is 97.3 ± 1.2 %, while aluminium dissolution is limited to 41.2 %.

3. The second-order model based on the Box–Behnken design shows high adequacy (R^2 = 0.9818; predicted R^2 = 0.9134); the factors rank by influence as acid concentration > temperature > L:S ratio > time.

4. The leaching kinetics follow the chemical-reaction-controlled form of the shrinking core model; kinetic parameters for GIAP-8 catalyst in HNO_3 media are reported for the first time.

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5. Compared with H_2SO_4, HNO_3 provides higher nickel recovery, no diffusion barrier layer and a lower temperature for obtaining NiO; the results provide a basis for developing a technology for processing spent nickel catalysts.

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OKSIDLANGAN MIS RUDALARI TARKIBIDAGI OLTIN VA KUMUSHNI GRAVITATSION BOYITISH USULIDA AJRATIB OLISHNING TEXNOLOGIK IMKONIYATLARINI TADQIQ QILISH

G‘ofurova Sarvinoz Qaxramon qizi
Olmaliq davlat texnika instituti magistranti
Masidikov Elyor Mirsodikovich v.v.b.,(PhD) dotsent
Olmaliq davlat texnika instituti (O’zbekiston Respublikasi Toshkent viloyati Olmaliq Shahri)

Annotatsiya: *Oksidlangan mis rudalari tarkibidagi qimmatbaho metallarni samarali ajratib olish mineral xomashyodan kompleks foydalanishning dolzarb masalaridan biri bo’lib kelmoqda. Ayniqsa, oltin va kumushni ularning fizik xususiyatlari, jumladan, zichlik farqidan foydalanib gravitatsion boyitish usulida ajratish muhim texnologik ahamiyatga ega. Gravitatsion boyitish jarayonida mineral zarrachalarning o‘lchami, zichligi va erkinlanish darajasi ajratish samaradorligiga bevosita ta'sir ko‘rsatadi. Konsentratsion stol, jig konsentratori hamda markazdan qochma separatorlardan foydalanish orqali qimmatbaho metallarni konsentrat tarkibida to‘plash imkoniyatlari mavjud. Mazkur texnologiyaning afzalliklari va cheklovlarini o‘rganish oksidlangan mis rudalarini kompleks qayta ishlash samaradorligini oshirishda muhim ahamiyat kasb etadi.*

Kalit so‘zlar: *oksidlangan mis rudalari, oltin, kumush, gravitatsion boyitish, mineral zichligi, zarracha o‘lchami, konsentratsion stol, jig konsentratori, markazdan qochma separator, qimmatbaho metallar.*

Abstract: *The recovery of gold and silver from oxidized copper ores by gravity concentration is a promising approach to the integrated processing of mineral resources. The efficiency of this process depends on mineral density, particle size, and degree of liberation. The application of gravity concentration technologies provides opportunities to enrich precious metals and improve the efficiency of subsequent metallurgical processes.*

Keywords: *oxidized copper ores, gold, silver, gravity concentration, mineral density, concentrate, precious metals.*

Аннотация: *Извлечение золота и серебра из окисленных медных руд методом гравитационного обогащения является перспективным направлением комплексной переработки минерального сырья. Эффективность процесса зависит от плотности минералов, крупности*

частиц и степени их раскрытия. Применение гравитационных технологий позволяет концентрировать благородные металлы и повышать эффективность последующих металлургических процессов.

Ключевые слова: *окисленные медные руды, золото, серебро, гравитационное обогащение, плотность минералов, концентрат, благородные металлы.*

Kirish: Hozirgi kunda metallurgiya sanoatida oksidlangan mis rudalari tarkibidagi oltin va kumushni samarali ajratib olish mineral xomashyo resurslaridan kompleks foydalanishning amaliy ahamiyatini kuchaytirmoqda.. Ushbu metallarni ajratishda gravitatsion boyitish usuli ularning fizik xususiyatlari, xususan, zichlik farqiga asoslanadi. Oltinning zichligi 19,3 g/cm³ bo‘lib, bu ko‘rsatkich ko‘plab bo‘sh jins minerallariga nisbatan ancha yuqori.

Gravitatsion boyitish jarayonida rudaning maydalanganlik darajasi, mineral zarrachalarning o‘lchami va erkinlanish holati muhim ahamiyatga ega. Konsentratsion stol, jig va markazdan qochma separatorlardan foydalanish orqali erkin oltin hamda tarkibida kumush bo‘lgan zich minerallarni konsentratga to‘plash mumkin. Shu sababli oksidlangan mis rudalarini gravitatsion boyitish texnologiyasini o‘rganish qimmatbaho metallarni kompleks ajratib olishda muhim ilmiy-amaliy ahamiyat kasb etadi.

Oksidlangan mis rudalari tarkibidagi oltin va kumushni ajratib olish mineral xomashyodan kompleks foydalanish, qimmatbaho komponentlarni qayta ishlashga jalb etish hamda metallurgik ishlab chiqarish samaradorligini oshirishning muhim yo‘nalishlaridan hisoblanadi. Ayniqsa, tarkibida mis bilan bir qatorda oz miqdorda uchraydigan oltin va kumushni ajratib olish mavjud mineral resurslardan oqilona foydalanishda katta amaliy ahamiyatga ega.

O‘zbekistonning Qalmoqqir koni oksidlangan rudalari bunga misol bo‘la oladi. Mazkur konning 39-sonli ag‘darmasidagi 74,5 mln tonna rudada mis miqdori 0,23%, oltin miqdori 0,424 g/t, kumush miqdori esa 1,77 g/t ekanligi qayd etilgan. Ushbu ko‘rsatkichlar oksidlangan mis rudalari tarkibidagi qimmatbaho metallarni qo‘shimcha boyitish va ajratib olish imkoniyatlarini o‘rganish zarurligini ko‘rsatadi.

Gravitatsion boyitish samaradorligi oltin va kumushning ajratib olish jarayoni ham amaliy ham iqtisodiy jihatdan dolzarb bo’lib kelmoqda. Jumladan, Qalmoqqir konining oksidlangan rudalari Knelson MD3 markazdan qochma konsentratorida boyitilganda oltinning ajratib olinishi 52,2%, kumushniki esa 6% ni tashkil etgan. Bu natija oltin va kumushning gravitatsion ajralish xususiyatlari bir-biridan farq qilishini ko‘rsatadi.

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Konsentratsion stol yordamida oltin va kumushni ajratish bo‘yicha boshqa xomashyo turlarida ham ijobiy natijalar olingan. Masalan, 2025-yilda metallurgik shlaklarni gravitatsion boyitish bo‘yicha o‘tkazilgan tadqiqotda oltinning 56,16%, kumushning esa 51,82% ajratib olingan. Ushbu natijalar konsentratsion stolning qimmatbaho metallarni boyitishdagi imkoniyatlarini ko‘rsatadi.

Oksidlangan mis rudalarini gravitatsion boyitishning amaliy ahamiyati shundaki, cho‘ktirish mashinasi va konsentratsion stolni ketma-ket qo‘llash orqali erkin oltin hamda kumush saqlovchi zich mineral zarrachalarni alohida konsentratga to‘plash mumkin. Bu esa qimmatbaho metallarni keyingi metallurgik qayta ishlashga tayyorlash, ularning yo‘qotilishini kamaytirish va mineral xomashyodan kompleks foydalanish imkoniyatlarini kengaytiradi.

Xulosa: Oksidlangan mis rudalari tarkibidagi oltin va kumushni gravitatsion boyitish usulida ajratib olish imkoniyatlarini o‘rganish natijasida ushbu usulning qimmatbaho metallarni kompleks qayta ishlashdagi ahamiyati aniqlandi. Tadqiqotda qo‘llanilgan cho‘ktirish mashinasi va konsentratsion stol gravitatsion boyitishning muhim qurilmalari hisoblanadi. Cho‘ktirish mashinasida mineral zarrachalar zichligiga qarab qatlamlanadi, konsentratsion stolda esa boyitilgan mahsulotni qo‘shimcha ajratish va tozalash amalga oshiriladi. Ushbu qurilmalarni ketma-ket qo‘llash oltin va kumush saqlovchi og‘ir fraksiyalarni ajratish imkoniyatini oshirishi mumkin.

Umuman olganda, cho‘ktirish mashinasi va konsentratsion stoldan foydalanish oksidlangan mis rudalarini kompleks qayta ishlash, oltin va kumush saqlovchi og‘ir fraksiyalarni ajratish hamda keyingi metallurgik jarayonlarga tayyorlash uchun istiqbolli texnologik yechim hisoblanadi.

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OKSIDLI MIS RUDALARIDAN OLTIN VA KUMUSHNI GRAVITATSION USULDA BOYITISH TEXNOLOGIYASINI TAKOMILLASHTIRISH

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Annotatsiya: *Ushbu maqolada tarkibida oltin (Au) va kumush (Ag) bo'lgan oksidli mis rudalarini kompleks qayta ishlashning dolzarb masalalari yoritilgan. Qimmatbaho metallarni gravitatsion usulda ajratib olishning texnologik afzalliklari, jarayon samaradorligiga salbiy ta'sir ko'rsatuvchi omillar hamda markazdan qochma kuchlar va kombinatsiyalashgan sxemalar yordamida mavjud muammolarni bartaraf etish yo'llari tahlil qilingan.*

Kalit so'zlar: *oksidli mis rudasi, oltin, kumush, gravitatsion boyitish, markazdan qochma konsentrator, shlamlanish, kompleks qayta ishlash.*

Abstract: *This article discusses current issues related to the integrated processing of oxidized copper ores containing gold (Au) and silver (Ag). It analyzes the technological advantages of gravity separation for recovering precious metals, the factors that negatively affect process efficiency, and possible solutions to existing challenges through the application of centrifugal forces and combined processing flowsheets.*

Keywords: *oxidized copper ore, gold, silver, gravity concentration, centrifugal concentrator, slime formation, integrated processing.*

Аннотация*: В данной статье рассматриваются актуальные вопросы комплексной переработки окисленных медных руд, содержащих золото (Au) и серебро (Ag). Проанализированы технологические преимущества гравитационного метода извлечения благородных металлов, факторы, отрицательно влияющие на эффективность процесса, а также пути решения существующих проблем с использованием центробежных сил и комбинированных технологических схем.*

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Ключевые слова: *окисленная медная руда, золото, серебро, гравитационное обогащение, центробежный концентратор, ошламование, комплексная переработка*

Kirish: Jahon kon-metallurgiya sanoatida boy va qayta ishlash texnologiyasi oson bo‘lgan sulfidli mis rudalari zaxiralarining tobora kamayib borishi ishlab chiqarishga katta hajmdagi oksidli va aralash tarkibli rudalarni jalb qilishni taqozo etmoqda. O‘zbekistonning yirik rangli metall konlari (jumladan, Qalmoqqir, Dalnee va boshqa konlar) ustki qatlamlarida ham millionlab tonna oksidli va aralash mis rudalari mavjud bo‘lib, ularning tarkibida asosiy komponent — misdan tashqari sanoat ahamiyatiga ega bo‘lgan oltin (Au) va kumush (Ag) uchraydi.

Amaliyotda oksidli mis rudalarini qayta ishlash asosan sulfat kislotali tanlab eritish (gidrometallurgiya) yoki oldindan sulfidlashtiruvchi reagentlar yordamida flotatsiya qilish orqali amalga oshiriladi. Biroq, har ikkala usulda ham ruda tarkibidagi erkin va yirik oltin hamda kumush zarralari eritmalar yoki flotoreagentlar ta’siriga to‘liq berilmaydi. Natijada qimmatbaho metallarning katta qismi boyitish chiqindilariga (xvostlarga) o‘tib ketadi. Shu sababli, maydalash siklining dastlabki bosqichlaridayoq oltin va kumushni gravitatsion usulda ajratib olish resurs tejamkorligini oshirish, chiqindisiz texnologiyalarni yaratish va korxona rentabelligini yuksaltirishda o‘ta dolzarb ahamiyat kasb etadi.

O‘zbekiston Respublikasining eng yirik sanoat gigantlaridan biri bo‘lgan «Olmaliq kon-metallurgiya kombinati» AJ (OKMK) xomashyo bazasida Qalmoqqir mis-porfir koni alohida strategik o‘rin tutadi. 1954-yildan buyon uzluksiz ekspluatatsiya qilinayotgan ushbu konda uzoq yillik qazish ishlari natijasida yuqori gorizontlardagi oksidlanish zonasi rudalari hamda tarkibida ma’lum miqdorda rangli va qimmatbaho metallar bo‘lgan ko‘p million tonnalik balansdan tashqari ruda uyumlari shakllangan. Bugungi kunda «Yoshlik-1» konini o‘zlashtirish va 3-mis boyitish fabrikasini (3-MBF) ishga tushirish sharoitida mavjud xomashyo resurslaridan kompleks va samarali foydalanish iqtisodiy va ilmiy-texnologik masalaga aylangan.

Oksidli mis rudalarini qayta ishlash amaliyotida ikkita asosiy yo‘nalish — sulfidlashtiruvchi reagentlar (masalan, natriy sulfid) ishtirokidagi flotatsiya hamda sulfat kislotali tanlab eritish (gidrometallurgiya) keng qo‘llaniladi. Biroq, amaliy tajribalar shuni ko‘rsatadiki, har ikkala usulda ham ruda tarkibidagi erkin va yirik oltin-kumush zarralari asosiy mahsulotga to‘liq o‘tmaydi. Xususan, kislotali tanlab eritish jarayonida mis minerali eritmaga o‘tadi, ammo oltin va kumush kislotada erimaganligi sababli qattiq chiqindi (kek) tarkibida qolib ketadi. Flotatsiya jarayonida esa og‘ir solishtirma massaga ega bo‘lgan erkin oltin zarralari flotatsion

mashina kameralarining tubiga cho‘kib qoladi va chiqindiga (xvostga) chiqib ketadi. Shu nuqtayi nazardan, maydalash siklining dastlabki bosqichlaridayoq gravitatsion boyitish usullarini qo‘llash orqali erkin oltin va kumushni tezkor ajratib olish mavzuning naqadar dolzarb ekanligini belgilaydi.

Qalmoqqir mis-porfir konining yuqori oksidlanish zonasidan qazib olinayotgan oksidlangan mis rudalari hamda kon hududida to‘plangan balansdan tashqari ruda uyumlari (xususan, A7, A8 va №10 raqamli balansdan tashqari uyumlar) tanlab olingan. Ushbu rudalar geologik jihatdan murakkab tarkibga ega bo‘lib, ularda birlamchi sulfid minerallari gipergen jarayonlar ta’sirida oksidli, karbonatli va silikatli birikmalarga aylangan.

Kimyoviy va mineralogik tahlil natijalariga ko‘ra, Qalmoqqir konining oksidlangan va balansdan tashqari rudalari quyidagi asosiy ko‘rsatkichlar bilan tavsiflanadi: Ruda tarkibida umumiy misning massa ulushi o‘rtacha 0,13% dan 0,45% gacha o‘zgarib turadi. Oksidlangan mis shakllari umumiy misning 60–85% qismini tashkil etadi. Jins hosil qiluvchi asosiy oksidlar kremniy dioksidi SiO_2 (48,5–52,0%), alyuminiy oksidi Al_2O_3 (11,5–13,5%), temir oksidlari Fe_2O_3 + FeO (5,5–8,2%), kaliy va natriy oksidlari (4,0–5,5%) hamda oltingugurtdan (0,3–1,2%) iborat**.** Oksidlangan zonada mis asosan malaxit $Cu_2CO_3(OH)_2$, azurit $Cu_3(CO_3)_2(OH)_2$, xrizokolla $(Cu,Al)_2H_2Si_2O_5(OH)_4 \cdot nH_2O$, kuprit Cu_2O hamda kam miqdorda tug‘ma mis ko‘rinishida uchraydi. Shuningdek, oksidlanishga to‘liq ulgurmagan qoldiq sulfidlar — xalkopirit, xalkozin va kovellin ham mavjud.

Rudaning asosiy massasini kvars, dala shpatlari (ortoklaz, plagioklaz), seritsit, xlorit, biotit kabi slyudali minerallar hamda temir gidrooksidlari (limonit, getit) tashkil etadi. Slyudali va gilli minerallarning ko‘pligi ruda maydalanganda o‘ta mayda loyqa zarrachalar (birlamchi va ikkilamchi shlamlar) hosil bo‘lishiga olib keladi.

1-jadval. Qalmoqqir koni oksidlangan mis rudalari tarkibidagi asosiy minerallarning fizik-texnologik xossalari

Mineral nomi	**Kimyoviy formulasi**	**Zichligi, g/sm³**	**Gravitatsion boyitishdagi xulq-atvori**
Tug‘ma oltin	Au	15,6 – 19,3	Og‘ir fraksiyaga (konsentratga) faol cho‘kadi
Tug‘ma kumush	Ag	10,1 – 10,5	Og‘ir fraksiyaga o‘tadi, tez yassilanadi
Elektrum	Au, Ag	12,0 – 15,0	Yuqori zichlik hisobiga gravitatsiyada ushlanadi
Pirit	FeS_2	4,9 – 5,2	Oraliq og‘ir fraksiyada oltin tashuvchi sifatida ajraladi
Malaxit / Azurit	$Cu_2CO_3(OH)_2$	3,7 – 4,0	Mo‘rt, tez maydalanib shlam hosil qiladi

Xrizokolla	$CuSiO_3 \cdot nH_2O$	2,0 – 2,4	Yengil va g‘ovak, suv oqimi bilan yuvilib ketadi
Kvars / Dala shpati	SiO_2	2,6 – 2,7	Asosiy yengil chiqindi (xvost) jinsini tashkil qiladi

Qimmatbaho metallarni samarali ajratib olish texnologiyasini ishlab chiqish uchun ularning rudada uchrash shakllari, o‘lchamlari va boshqa minerallar bilan o‘simta (srostok) hosil qilish xususiyatlarini aniq bilish talab etiladi. Qalmoqqir konining oksidlangan rudalarida o‘tkazilgan mineralogik va ratsional (fazaviy) tahlillar oltin va kumushning taqsimlanishida quyidagi muhim qonuniyatlarni aniqlagan: Oltin rudada asosan tug‘ma (erkin) holda, shuningdek kumush bilan tabiiy qattiq eritmalar — elektrum (Ag miqdori 20–50%) va kyustelit (Ag miqdori 50% dan yuqori) ko‘rinishida uchraydi. Bundan tashqari, telluridlar sinfiga mansub petsit (Ag_3AuTe_2) va kalaverit minerallari qayd etilgan. Kumush esa tug‘ma kumush, elektrum, argentit (Ag_2S) hamda xalkozin va limonit tarkibidagi izomorf aralashmalar shaklida tarqalgan. Qalmoqqir oksidlangan rudalaridagi tug‘ma oltinning o‘rtacha probasi 890 atrofida bo‘lib, u yuqori soflik darajasiga ega. Granulometrik tahlillar shuni ko‘rsatadiki, oltin zarralari asosan mayda (0,05–0,1 mm) va o‘ta mayda dispers (0,02 mm dan kichik) sinflarda jamlangan. Yirik (0,1 mm dan katta) tug‘ma oltin zarralari kamroq uchraydi, biroq ular umumiy oltin zaxirasining salmoqli ulushini tashkil qiladi.

Oksidlangan mis rudalarida oltinning taxminan 42–45% qismi erkin (tug‘ma) va sianidlanuvchi ochiq yuzali zarralar holida mavjud. Taxminan 35–40% oltin oksidlanishga ulgurmagan qoldiq sulfid minerallari (pirit, xalkopirit) ichida o‘simta holida joylashgan. Qolgan 15–20% qismi esa temir gidrooksidlari (limonit, getit) va kvars-silikatli jinslar ichida submikroskopik (1–5 mkm) darajada qamalgan holda uchraydi.

Qalmoqqir oksidli rudalaridan oltin va kumushni gravitatsion usulda boyitishning asosiy afzalliklari quyidagilardan iborat:

- **Ekologik xavfsizlik.** Jarayon davomida zaharli kimyoviy birikmalar (sianidlar, ksanthogenatlar va boshqa flotoreagentlar) ishlatilmaydi. Asosiy texnologik muhit sifatida oddiy aylanma suv qo‘llaniladi, bu esa atrof-muhitga va chiqindi omborlariga tushadigan ekologik yukni keskin kamaytiradi.
- **Iqtisodiy samaradorlik.** Qimmatbaho reagentlarga mablag‘ sarflanmasligi, uskunalarning nisbatan sodda tuzilishi va energiya sarfining kamligi tufayli qayta ishlash tannarxi flotatsiya va gidrometallurgiyaga nisbatan sezilarli darajada past bo‘ladi.
- **Metallarning qayta maydalanishini oldini olish.** Yopiq maydalash siklining o‘zidayoq (tegirmon va klassifikator orasida) erkin oltin va kumush

zarralarini ajratib olish ularning tegirmonda haddan tashqari ezilib, yassilanib va shlamlanib ketishining oldini oladi.

- Shu bilan birga, Qalmoqqir konining oksidli rudalarini an'anaviy gravitatsion uskunalarda (shlyuzlar, cho‘ktirish mashinalari, konsentratsion stollar) boyitishda bir qator jiddiy kamchiliklar va texnologik muammolar yuzaga keladi:

- **O‘ta mayda zarralarning yuvilib ketishi.** An'anaviy gravitatsion apparatlarda o‘lchami 0,074 mm (74 mkm) dan kichik bo‘lgan dispers oltin va kumush zarralarini ushlab qolish samaradorligi keskin pasayadi, chunki ularning cho‘kish tezligi suv oqimining ko‘tarish kuchidan kichik bo‘ladi.

- **Oksidli minerallarning mo‘rtligi va shlamlanishi.** Malaxit, xrizokolla, limonit va gilli minerallar maydalash jarayonida tez uqalanib, ko‘p miqdorda loyqa (shlam) hosil qiladi. Shlam suvning zichligi va qovushqoqligini oshirib, og‘ir metall zarralarining cho‘kishiga to‘sqinlik qiladi.

- **Bog‘langan metallarni ajrata olmaslik.** Gravitatsion usul faqat ochilgan (erkin) metall zarralarini va og‘ir sulfid o‘simtalarini ajratadi. Kvars yoki temir oksidlari ichida submikroskopik darajada qamalgan oltin-kumush gravitatsiya chiqindisiga o‘tib ketadi.

Qalmoqqir konining oksidlangan va balansdan tashqari rudalaridan oltin va kumushni ajratib olish darajasini oshirish uchun texnologik jarayonni kompleks tarzda takomillashtirish talab etiladi. Buning uchun zamonaviy boyitish amaliyotida quyidagi ilmiy-texnik yechimlar taklif etiladi:

- **Markazdan qochma gravitatsion konsentratorlarni joriy etish.** Oddiy gravitatsiya apparatlari o‘rniga Knelson yoki Falcon turidagi markazdan qochma konsentratorlarni qo‘llash 60G dan 200G gacha bo‘lgan markazdan qochma tezlanish maydonini yaratadi. Bu esa o‘lchami 10–20 mikrongacha bo‘lgan mayda oltin, elektrum va kumush zarralarini ham yuqori samaradorlik bilan ushlab qolish imkonini beradi.

- **Oldindan shlamsizlantirish (deshlamatsiya) operatsiyasini kiritish.** Maydalangan rudani gravitatsion boyitishga uzatishdan avval gidrotsiklonlar yordamida -0,020 mm li loyqa shlam sinfini ajratib tashlash suv muhitining qovushqoqligini normallashtiradi va konsentratorlarning ajratish aniqligini 12–18% ga oshiradi.

- **Kombinatsiyalashgan gravitatsion-gidrometallurgik sxemaga o‘tish.** Gravitatsiya jarayonidan chiqqan boyitma (konsentrat) to‘g‘ridan-to‘g‘ri metallurgik qayta ishlashga (eritishga) yuboriladi. Gravitatsiya chiqindisi (xvost) esa ikki bosqichda qayta ishlanadi: avval sulfat kislota bilan chanlarda tanlab eritish orqali oksidlangan mis ajratib olinadi, so‘ngra qoldiq kek tarkibidagi mayda va

bog‘langan oltin-kumush ekologik xavfsiz tiosulfatli yoki karbamidli erituvchilar yordamida tanlab eritiladi.

2-jadval. Qalmoqqir oksidlangan rudalarini qayta ishlashda muammolar va ularning texnologik yechimlari

Texnologik muammo	Taklif etilayotgan yechim	Kutilayotgan texnologik samara
Mayda dispers Au va Ag zarralarining (<74 mkm) an’anaviy uskunalarda yuvilib ketishi	Maydalash sikli ichida Knelson / Falcon markazdan qochma konsentratorlarini o‘rnatish	10–20 mkm gacha bo‘lgan mayda zarralarni ushlash va erkin Au/Ag ning 45–60% ini gravitatsiyada ajratish
Xrizokolla, malaxit va gilli minerallarning ezilib, loyqa (shlam) hosil qilishi	Bosqichli maydalash va gidrotsiklonlar yordamida oldindan deshlamatsiya qilish	Pulpa qovushqoqligini kamaytirish va gravitatsion ajralish aniqligini 15% gacha oshirish
Sulfidlar va temir gidrooksidlari ichida qamalgan submikroskopik Au/Ag yo‘qotilishi	Gravitatsion konsentratdan og‘ir pirit fraksiyasini ajratish va mayin yanchib eritish	O‘simta holidagi oltin va kumushni qo‘shimcha ravishda boyitmaga jalb qilish
To‘g‘ridan-to‘g‘ri kislotali eritishda qimmatbaho metallarning kekda qolib ketishi	Kombinatsiyalashgan sxema: Gravitatsiya → Kislotali tanlab eritish (Cu) → Tiosulfatli eritish (Au, Ag)	Misni 80% gacha, oltin va kumushni esa umumiy 75–85% gacha kompleks ajratib olish

Taklif etilayotgan kombinatsiyalashgan texnologiyani Qalmoqqir konining oksidlangan va balansdan tashqari rudalariga tatbiq etish natijasida quyidagi ilmiy-amaliy ko‘rsatkichlarga erishish kutilmoqda: Qimmatbaho metallarni ajratish darajasining oshishi. Gravitatsion bosqichning o‘zidayoq ruda tarkibidagi erkin oltin va kumushning 45–60% qismi yuqori sifatli gravitatsion konsentratga o‘tkaziladi. Keyingi gidrometallurgik bosqichlar bilan birgalikda Au va Ag ning umumiy ajratib olish darajasi 75–85% gacha yetkaziladi. Xomashyo bazasining kengayishi**.** Yillar davomida to‘planib qolgan balansdan tashqari oksidli ruda uyumlarini sanoat miqyosida qayta ishlashga jalb qilish orqali OKMKning qo‘shimcha tayyor mahsulot (katodli mis, affinajlangan oltin va kumush) ishlab chiqarish hajmi ortadi. Ekologik va iqtisodiy barqarorlik**.** Zaharli sianid va qimmat flotoreagentlar sarfini kamaytirish, mavjud chiqindi uyumlari egallab turgan yer maydonlarini bo‘shatish hamda ishlab chiqarish tannarxini pasaytirish hisobiga yuqori iqtisodiy samaradorlikka erishiladi.

Amaliy tadqiqotlar shuni ko‘rsatadiki, maydalash siklida Knelson yoki Falcon markazdan qochma konsentratorlarini qo‘llash an’anaviy shlyuzlarga nisbatan mayda oltin zarralarini ajratib olish samaradorligini 1,5–2 barobar oshiradi. Gravitatsion boyitishdan chiqqan chiqindilarni (xvostlarni) esa Na_2S (natriy sulfid)

yordamida sulfidlashtirib flotatsiyalash yoki sulfat kislotali/tiosulfatli tanlab eritish (vyshchelachivanie) jarayoniga yo‘naltirish xomashyodan kompleks foydalanish imkonini yaratadi.

Xulosa: Oksidli mis rudalaridan oltin va kumushni gravitatsion usulda boyitish ekologik toza, kam xarajatli va yuqori samarali boshlang‘ich texnologiya hisoblanadi. Biroq, oksidli minerallarning shlamlanishga moyilligi va dispers oltin zarralarining yuvilib ketishi ushbu usulni zamonaviy apparatlar bilan takomillashtirishni talab etadi. Maydalash sikli ichida markazdan qochma konsentratorlarni joriy etish, gidrotsiklonlarda oldindan deshlamatsiya o‘tkazish hamda gravitatsion boyitishni flotatsion va gidrometallurgik jarayonlar bilan kombinatsiyalash qimmatbaho metallarning umumiy ajratib olish darajasini 15–25% ga oshirish va kon-metallurgiya korxonalarining iqtisodiy samaradorligini sezilarli darajada yuksaltirish imkonini beradi.

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RFID-TIZIM KONFIGURATSIYASINI TANLASHDA KUTUBXONA TALABLARIGA MUVOFIQLIKNI TEKSHIRISH VA VARIANTLARNI BAHOLASH MODELLARI

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Annotatsiya. *Maqolada kutubxona uchun RFID-tizim konfiguratsiyasini tanlash modellari va algoritmlari bayon qilingan. Muvofiqlik uch qiymatli baho bilan tekshiriladi, qurilmalar soni nusxalar oqimidan seanslar oqimiga o‘tish orqali asoslanadi. Joiz variantlar Pareto filtri va qat’iy shkalali additiv model bilan taqqoslanadi; shoxlarni xavfsiz kesish sharti isbotlangan.*

Kalit so‘zlar: *RFID, kutubxona, konfiguratsiya, uch qiymatli mantiq, o‘tkazish qobiliyati, Pareto samaradorligi, umumiy egalik qiymati.*

Аннотация. *В статье изложены модели и алгоритмы выбора конфигурации RFID-системы для библиотеки. Соответствие проверяется трёхзначной оценкой, число устройств обосновывается переходом от потока экземпляров к потоку сеансов. Допустимые варианты сравниваются Парето-фильтром и аддитивной моделью с фиксированными шкалами; доказано условие безопасного отсечения ветвей.*

Ключевые слова: *RFID, библиотека, конфигурация, трёхзначная логика, пропускная способность, Парето-эффективность, совокупная стоимость владения.*

Abstract. *The paper presents models and algorithms for selecting an RFID system configuration for a library. Compliance is checked by a three-valued assessment, and the number of devices is justified by a transition from the item flow to the session flow. Feasible alternatives are compared by a Pareto filter and an additive model with fixed scales; a safe pruning condition is proved.*

Keywords: *RFID, library, configuration, three-valued logic, throughput, Pareto efficiency, total cost of ownership.*

Kirish

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Kutubxonada RFID texnologiyasini joriy etish o‘zaro bog‘liq vositalarni tanlashni talab qiladi: metkalar, xodim stansiyalari, o‘z-o‘ziga xizmat terminallari, darvozalar, inventarizatsiya qurilmalari va avtomatlashtirilgan axborot-kutubxona tizimi (AAKT) bilan almashish moduli. O‘z-o‘ziga xizmat terminali kitobxon kartasini o‘qishi va AAKT bilan SIP2 protokoli orqali ishlashi kerak [1]. ISO 28560 standartlari metkadagi ma’lumotlar elementlari va ularni kodlashni belgilaydi [2; 3], qurilmalar tarkibi va sonini tanlash tartibi ularda berilmagan. Respublikada integrallashgan axborot-kutubxona tizimlarini yaratish modellari ishlab chiqilgan [4]; RFID-tizimni bunday muhitga ulashda uskunalar tarkibini asoslash alohida masala bo‘lib qoladi.

Amaliyotda mezonlarga 1–5 ballik vazn va baho beriladi [5] yoki yetkazib beruvchi so‘rovnomasi orqali kutubxonadan terminallar va darvozalar soni to‘g‘ridan-to‘g‘ri so‘raladi, AAKT bilan moslik tizim nomi bo‘yicha aniqlanadi. Ikkala usulda qurilmalar orasidagi bog‘liqliklar, xizmat yuklamasi va ma’lumotlarning to‘liqsizligi rasmiy hisobga olinmaydi. Maqolada konfiguratsiyalash nazariyasining cheklovlar apparati [6; 7] va qiymat funksiyalari nazariyasi [8] kutubxona jarayonlariga moslashtirilgan. Tadqiqot HF diapazoni (13,56 MGs, ISO/IEC 15693) bilan cheklangan; diapazon komponentlar katalogi orqali beriladi.

Asosiy qism

Kutubxona profili $\mathcal{L}$ fond, talablar, yuklamalar, mavjud vositalar va tashkiliy shartlarni birlashtiradi. Har bir parametr uchun qiymat, birlik, davr, manba va maqom qayd etiladi; maqom manba ko‘rsatkichi, kasbiy tavsiya, model farazi yoki hisoblangan qiymat bo‘lishi mumkin. Noma’lum qiymat $\perp$ bilan belgilanadi va nol bilan almashtirilmaydi. Har bir majburiy operatsiya $o \in \mathcal{O}_{req}$ uchun zarur funksiyalar to‘plami $\mathcal{F}_o$ beriladi. Shu tariqa «jarayon — talab — funksiya» bog‘lanishi rasmiy shaklga keltiriladi.

Konfiguratsiya katalog pozitsiyalari $j \in \mathcal{J}$ (uskunalar, metkalar, litsenziyalar) bo‘yicha xarid qilinadigan x_j, qayta foydalaniladigan u_j miqdorlar va mavjudlik belgisi $z_j \in \{0,1\}$ bilan tavsiflanadi. Muallif tomonidan pozitsiyalar orasidagi bog‘liqliklar ikki turdagi cheklov bilan ifodalangan:

$$z_j \le z_{j'}, \ \forall j' \in S; \qquad z_j \le \sum_{j' \in S} z_{j'} \tag{1}$$

bu yerda $S \subseteq \mathcal{J}$ — j pozitsiya ishlashi uchun zarur pozitsiyalar. AND cheklovi terminalning AAKT bilan almashish modulisiz ishlamasligini ifodalaydi. OR

cheklovi karta o‘qishning muqobil usullaridan kamida bittasi tanlanishini talab qiladi. Domenlar chekli bo‘lgani uchun qidiruv sohasi $\mathcal{X}$ ham chekli.

Muvofiqlik $\mathbb{V} = \{\mathrm{T}, \mathrm{F}, \mathrm{U}\}$ natijalari bilan baholanadi: mos keladi, mos kelmaydi, ma’lumot yetarli emas. Operatsiya o uchun funksional to‘liqlik va konfiguratsiyaning umumiy natijasi quyidagicha aniqlanadi:

$$\mathrm{cov}_o(\boldsymbol{x}) = \min_{f \in \mathcal{F}_o} \max_{j:\, z_j = 1,\, f \in \mathcal{F}_j} s_{j,f}, \qquad \sigma(\boldsymbol{x}) = \min_{h \in \mathcal{R}_{hard}} \sigma_h(\boldsymbol{x}) \tag{2}$$

bu yerda $s_{j,f} \in \mathbb{V}$ — j pozitsiyada f funksiyaning tasdiqlanganlik holati; σ_h — majburiy shart h ning natijasi; F < U < T tartibi Kleene mantiqidagi kon’yunksiyaga mos keladi [9]. (2) dan kelib chiqadiki, bitta buzilgan shart variantni $\mathcal{X}_F$ ga o‘tkazadi, tasdiqlanmagan shart esa uni $\mathcal{X}_U$ da qoldiradi: bunday variant tavsiyaga kirmaydi, unga aniqlashtiriladigan shartlar ro‘yxati $\mathcal{H}_U$ biriktiriladi. AAKT nomining mos kelishi T natijasini bermaydi: almashish protokoli va versiyasi tasdiqlanishi kerak.

Hisobotlarda oqim nusxalarda beriladi, qurilmaning o‘tkazish qobiliyati esa seanslarda o‘lchanadi. Tadqiqotda ular orasida o‘tish zanjiri ishlab chiqilgan:

$$\lambda_e = \frac{k}{\Delta} \cdot \frac{L + R}{D}, \qquad \lambda_{s,o,c} = \frac{\pi_{o,c}\, \varphi_o\, \lambda_{e,o}}{\bar{b}_{o,c}} \tag{3}$$

bu yerda L, R — davrda berilgan va qaytarilgan nusxalar; D — ish kunlari; k — kunlik oqimning Δ soatlik hisob oynasidagi ulushi; $\lambda_{e,o}$ — o operatsiyaning nusxa oqimi; φ_o — markirovkalangan nusxalar bilan bajariladigan operatsiyalar ulushi; $\pi_{o,c}$ — c kanalga yo‘naltirilgan ulush; $\bar{b}_{o,c}$ — seansdagi nusxalarning o‘rtacha soni. Seans davomiyligi va g guruh qurilmalarining zarur soni:

$$t(b) = t^s + t^e b + \delta\,(\lceil b / b_{\max} \rceil - 1), \qquad \bar{t} = \sum_b p\,(b)\, t(b) \tag{4}$$

$$W_g = \sum_o \sum_{c \in \mathcal{C}_g} \lambda_{s,o,c}\; \bar{t}_{o,c,g} + W_g^{other}, \qquad n_{\min,g} = \left\lceil \frac{W_g}{3600\, \rho_{\max}} \right\rceil \tag{5}$$

bu yerda t^s — seansning doimiy qismi (identifikatsiya, AAKT bilan almashish); t^e — bir nusxaga sarflanadigan vaqt; $b_{\max}$ — bitta o‘qish siklining sig‘imi; δ — qo‘shimcha sikl vaqti; $p(b)$ — partiya hajmining taqsimoti; W_g^{other} — guruhdagi boshqa ish, masalan, shtrix-kod operatsiyalari; $\rho_{\max}$ — ruxsat etilgan yuklanish. Yaxlitlash chiziqli bo‘lmagani uchun $\bar{t}$ ni $\bar{b}$ orqali hisoblab bo‘lmaydi; navbatda kutish vaqti baholanmaydi.

Maktab axborot-resurs markazining model profilida 4 000 darslik besh kunda beriladi; $k = 0{,}30$ da hisob soatiga 240 nusxa, 10 nusxali komplektlarda 24 seans to‘g‘ri keladi. Shartli qiymatlar $t^s = 40$ s, $t^e = 2$ s, $b_{\max} = 10$, $\rho_{\max} = 0{,}8$ da $W = 1\,440$ s/soat va $n_{\min} = 1$. Har bir nusxa alohida seans deb olinsa, $W = 10\,080$

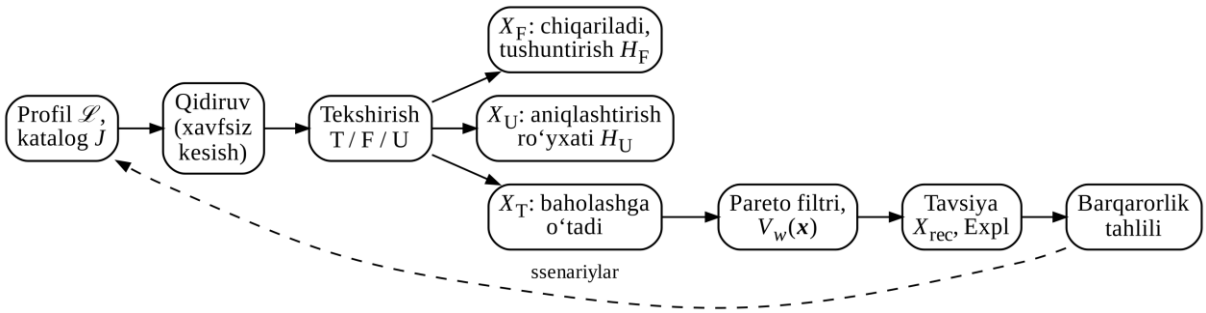
s/soat va $n_{\min} = 4$ chiqadi, ya'ni partiyani hisobga olmaslik stansiyalar sonini to'rt barobar oshiradi.

Xarajatlar Y yillik gorizontda $\mathrm{TCO} = \sum_j P_j\, x_j + C_{setup} + \sum_{y=1}^{Y} C_y$ ko'rinishida doimiy narxlarda hisoblanadi, komplekt tarkibidagi qismlar ikki marta qo'shilmaydi. Mezonlar oldindan belgilangan tayanch darajalar bo'yicha normallashtiriladi va additiv qiymat hisoblanadi:

$$\eta_\ell(\boldsymbol{x}) = \frac{f_\ell(\boldsymbol{x}) - f_\ell^-}{f_\ell^+ - f_\ell^-}, \qquad V_w(\boldsymbol{x}) = \sum_{\ell \in \mathcal{K}} w_\ell\ \eta_\ell(\boldsymbol{x}), \qquad \sum_{\ell \in \mathcal{K}} w_\ell = 1 \tag{6}$$

bu yerda f_ℓ^-, f_ℓ^+ — ℓ mezonning qat'iy tayanch darajalari (kamaytiriladigan mezonda surat $f_\ell^+ - f_\ell(\boldsymbol{x})$ ga almashtiriladi); $w_\ell \geq 0$ — qaror qabul qiluvchi shaxs yoki ssenariy beradigan vaznlar. Tayanch darajalar muqobillar to'plamiga bog'liq bo'lmagani uchun yangi variant qo'shilganda boshqa baholar o'zgarmaydi. V_w Pareto bo'yicha ustunlik qilinmaydigan variantlar $\mathcal{X}_P$ ga qo'llanadi. Additiv shakl mezonlarning afzallik bo'yicha mustaqilligini talab qiladi [8].

Modellar asosida to'rt algoritmdan iborat protsedura ishlab chiqilgan (1-rasm). Rasmdan ko'rinadiki, baholash faqat $\mathcal{X}_T$ uchun bajariladi, $\mathcal{X}_F$ va $\mathcal{X}_U$ tushuntirish bilan qaytariladi.



1-rasm. RFID-tizim konfiguratsiyasini tanlash protsedurasi

Tekshirish algoritmi $\sigma(\boldsymbol{x})$ bilan birga buzilgan va tasdiqlanmagan shartlar ro'yxatini kutubxonachi uchun tushuntirish sifatida chiqaradi; uni minimal shaklga keltirishda ziddiyatlarni tushuntirish usullari [10] qo'llanadi. Qidiruv algoritmi o'zgaruvchilarga qiymatlarni ketma-ket beradi. Qisman vektor $\boldsymbol{x}^{(i)}$ uchun kafolatlangan baho $\hat{\sigma}_h$ shart barcha to'ldirishlarda buzilganda F, barchasida bajarilganda T, aks holda U ga teng. Resurslar uchun barcha to'ldirishlarda o'rinli quyi chegara $\underline{A}_\zeta$ hisoblanadi. Shox $\hat{\sigma}_h = \mathrm{F}$ yoki $\underline{A}_\zeta > B_\zeta$ bo'lganda kesiladi, bu yerda B_ζ — byudjet yoki operatorlar soni kabi resurs chegarasi.

Tasdiq. Bu qoidalar bo'yicha kesish $\mathcal{X}_T \cup \mathcal{X}_U$ dan birorta konfiguratsiyani yo'qotmaydi. *Isbot.* Kesilgan shoxning har bir to'liq to'ldirishi $\boldsymbol{y}$ uchun birinchi holatda $\sigma_h(\boldsymbol{y}) = \mathrm{F}$, ikkinchisida $A_\zeta(\boldsymbol{y}) \geq \underline{A}_\zeta > B_\zeta$, ya'ni majburiy shart buziladi. (2) ga ko'ra ikkala holatda $\sigma(\boldsymbol{y}) = \mathrm{F}$ va $\boldsymbol{y} \in \mathcal{X}_F$. U bahosi kesishga asos bo'lmaydi.

To‘liq konfiguratsiyalar soni $N_{grid} = \prod_{i=1}^{n_x} \text{card}\,(\mathcal{D}_i)$ bilan chegaralangani sababli algoritm chekli qadamda tugaydi, bu yerda $\mathcal{D}_i$ — i-o‘zgaruvchining domeni.

Baholash algoritmi $\mathcal{X}_P$ ni juft taqqoslashlar bilan ajratadi va V_w maksimumiga erishgan variantlarni mezonlar hissasi $w_\ell \eta_\ell$ bilan birga tavsiya qiladi; narxi noma’lum variant taqqoslashga kirmaydi. Barqarorlik algoritmi yuklama, seans vaqtlari, narxlar va vaznlarni belgilangan oraliqlarda o‘zgartirib, joizlik va tanlovni qayta hisoblaydi. Tavsiyani almashtiradigan parametrlar birinchi navbatda aniqlashtiriladi.

Xulosa

1. Kutubxona talablari va RFID-tizim tarkibi AND/OR bog‘liqliklar va funksional to‘liqlik sharti orqali yagona butun sonli modelga birlashtirildi.

2. Uch qiymatli tekshiruv tasdiqlanmagan variantlarni tavsiyadan chiqaradi va aniqlashtiriladigan ma’lumotlarni ko‘rsatadi; kesish qoidalari joiz variantlarni yo‘qotmasligi isbotlandi.

3. Nusxalar oqimidan seanslar oqimiga o‘tish qurilmalar sonini partiya hajmi bilan asoslaydi; shartli misolda farq to‘rt barobarni tashkil etdi.

Keyingi bosqichda modellar dasturiy ta’minotda amalga oshiriladi va kutubxonalarning model profillarida hisoblash tajribasi o‘tkaziladi.

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СОВРЕМЕННЫЕ ПОДХОДЫ К СНИЖЕНИЮ ВРЕДНЫХ ВЫБРОСОВ ПРИ ОТКРЫТОЙ ДОБЫЧЕ РУДЫ С ИСПОЛЬЗОВАНИЕМ ИННОВАЦИОННЫХ ТЕХНОЛОГИЙ (НА ПРИМЕРЕ КАРЬЕРА «ЁШЛИК-1»)

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Аннотация. *Статья посвящена анализу источников вредных выбросов при открытой разработке рудных месторождений и обоснованию комплекса инновационных технологических решений, направленных на снижение техногенной нагрузки на атмосферный воздух. На примере карьера «Ёшлик-1» (Центральная Азия) рассмотрены основные источники пылегазовых загрязнений — буровзрывные работы, транспортно-погрузочный цикл и процессы дробления и сортировки руды. Разработана расчётная методика оценки массы выбросов, основанная на балансовом и диффузионном подходах. Показано, что внедрение комплексной системы пылеподавления, включающей автоматизированные оросительные установки, герметизацию дробильно-сортировочного оборудования и перевод части транспортного парка на электротягу, обеспечивает снижение суммарных выбросов на 35–40% при одновременном росте производительности. Полученные результаты имеют практическое значение для проектирования новых и модернизации действующих горнодобывающих предприятий Узбекистана и стран региона.*

Ключевые слова: *открытая добыча, вредные выбросы, пылеподавление, экологическая безопасность горного производства, карьер «Ёшлик-1», электрифицированный транспорт, устойчивое горное дело.*

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Abstract. *The article is devoted to analyzing sources of harmful emissions during open-pit mining of ore deposits and substantiating a set of innovative technological solutions aimed at reducing the technogenic load on atmospheric air. Using the "Yoshlik-1" open pit (Central Asia) as a case study, the main sources of dust and gas pollution are examined—blasting operations, the transport and loading cycle, and ore crushing and screening processes. A calculation methodology for estimating emission mass, based on balance and diffusion approaches, has been developed. It is shown that the introduction of a comprehensive dust suppression system, including automated irrigation units, sealing of crushing and screening equipment, and the conversion of part of the transport fleet to electric traction, ensures a 35–40% reduction in total emissions while simultaneously increasing productivity. The obtained results are of practical importance for the design of new and modernization of existing mining enterprises in Uzbekistan and the countries of the region.*

Keywords: *open-pit mining, harmful emissions, dust suppression, environmental safety of mining production, "Yoshlik-1" open pit, electrified transport, sustainable mining.*

Введение

Горнодобывающая промышленность занимает одну из ключевых позиций в экономике Узбекистана, обеспечивая существенную долю экспортных поступлений, занятости населения и развития сопутствующей инфраструктуры регионов. Однако интенсификация открытых горных работ, рост объёмов добычи и вовлечение в разработку более глубоких и труднообогатимых горизонтов месторождений сопровождаются увеличением техногенной нагрузки на окружающую среду. Наиболее значимым негативным эффектом открытой разработки является поступление в атмосферу значительных объёмов пыли, оксидов азота (NO_x), диоксида углерода (CO_2) и других загрязняющих веществ, образующихся в процессе буровзрывных работ, экскавации, транспортировки и переработки горной массы.

Проблема минимизации вредных выбросов при открытой добыче руды приобретает особую актуальность по нескольким причинам. Во-первых, ужесточение национальных и международных экологических нормативов вынуждает горнодобывающие предприятия пересматривать технологические регламенты и инвестировать в природоохранные мероприятия. Во-вторых, качество атмосферного воздуха в районах расположения карьеров напрямую влияет на состояние здоровья работников и населения прилегающих

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территорий, что делает задачу снижения выбросов не только экологической, но и социально значимой. В-третьих, современные тенденции декарбонизации промышленности и перехода к принципам устойчивого горного дела (sustainable mining) требуют комплексного переосмысления технологических цепочек добычи с учётом критериев энергоэффективности и экологичности.

Карьер «Ёшлик-1» является одним из крупнейших объектов открытой разработки в Центральной Азии и представляет собой удобную и репрезентативную площадку для апробации инновационных технологических решений, направленных на снижение вредных выбросов и повышение безопасности труда. Особенности горно-геологических условий месторождения, масштаб производственных процессов и разнообразие источников загрязнения делают результаты, полученные на данном объекте, применимыми к широкому кругу аналогичных предприятий региона.

Целью настоящего исследования является разработка и обоснование комплекса инновационных технологических решений по снижению вредных выбросов при открытой добыче руды на примере карьера «Ёшлик-1», а также количественная оценка их экологической и производственной эффективности.

Для достижения поставленной цели решались следующие задачи:

- анализ структуры и вклада основных технологических процессов в общий объём вредных выбросов карьера;
- разработка расчётной методики оценки массы выбросов пыли, CO_2 и NO_x;
- обоснование комплекса мероприятий по пылеподавлению и снижению газовых выбросов;
- количественная оценка эффективности предложенных решений с точки зрения экологических и производственных показателей;
- формулирование практических рекомендаций по внедрению разработанных решений на действующих и проектируемых горнодобывающих предприятиях.

Обзор литературы

Вопросам снижения экологической нагрузки при открытой разработке месторождений посвящено значительное число отечественных и зарубежных исследований. Традиционные подходы к оценке пылегазовых выбросов на карьерах базируются на нормативных методиках расчёта, учитывающих удельные показатели пылеобразования для различных технологических операций — бурения, взрывания, экскавации, транспортировки и переработки горной массы. Данные методики, как правило, ориентированы на усреднённые

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статистические показатели и не всегда учитывают специфику конкретного месторождения, климатические условия и особенности применяемого оборудования.

Значительное развитие в последние десятилетия получили модели диффузии загрязняющих веществ в приземном слое атмосферы, позволяющие описывать динамику распространения пылевых частиц и газообразных примесей с учётом скорости ветрового переноса, коэффициентов турбулентной диффузии и характеристик источников выбросов. Такие модели широко применяются при обосновании санитарно-защитных зон предприятий и оценке воздействия на здоровье персонала.

Отдельное направление исследований связано с разработкой и внедрением технических средств пылеподавления — оросительных систем, туманообразующих установок, аспирационного оборудования, а также с герметизацией технологического оборудования дробильно-сортировочных комплексов. Эффективность подобных решений подтверждена практикой их применения на ряде горнодобывающих предприятий, однако количественные оценки снижения выбросов существенно варьируются в зависимости от климатических условий, характеристик горной массы и конструктивных особенностей оборудования.

Важным трендом последних лет является электрификация карьерного транспорта, рассматриваемая как один из ключевых инструментов декарбонизации горнодобывающей отрасли. Переход на электросамосвалы и другие виды электрифицированной техники позволяет не только снизить прямые выбросы CO_2 и NO_x, образующиеся при сжигании дизельного топлива, но и сократить эксплуатационные расходы предприятия за счёт более высокой энергоэффективности электропривода. Вместе с тем внедрение электрифицированного транспорта на карьерах сопряжено с рядом технических ограничений, связанных с необходимостью развития зарядной инфраструктуры и адаптации горнотранспортных схем.

Отечественные исследования, посвящённые технологии открытых горных работ и экологической безопасности горного производства, заложили методологическую основу для комплексной оценки природоохранных мероприятий на карьерах Центральной Азии [1, 2]. В работах, посвящённых цифровизации мониторинга горных процессов, отмечается перспективность применения систем автоматического контроля за выбросами в реальном времени, что позволяет оперативно корректировать режимы работы пылеподавляющего оборудования [3]. Международные обзоры, подготовленные под эгидой природоохранных организаций, систематизируют

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глобальный опыт снижения загрязнения атмосферного воздуха горнодобывающими предприятиями и подчёркивают необходимость перехода к комплексным. [4].

Несмотря на значительный объём накопленных знаний, в существующей литературе недостаточно освещены вопросы комплексной оценки эффективности сочетания различных технологических мероприятий (пылеподавление, герметизация оборудования, электрификация транспорта) применительно к конкретным горно-геологическим и климатическим условиям месторождений Центральной Азии. Настоящее исследование направлено на восполнение указанного пробела на примере карьера «Ёшлик-1».

Материалы и методы исследования

3.1. Объект исследования

Объектом исследования являлся карьер «Ёшлик-1» — один из крупнейших объектов открытой разработки рудных месторождений в Центральной Азии. Технологическая схема предприятия включает полный цикл открытых горных работ: буровзрывную подготовку горной массы, экскавацию, транспортировку автомобильным транспортом, а также дробление и сортировку добытой руды.

3.2. Методология расчёта суммарных выбросов

В основу исследования положен балансовый метод оценки массы вредных выбросов, в соответствии с которым общая масса загрязняющих веществ определяется как сумма вкладов отдельных источников:

$$M_общ = \Sigma\ (M_пыль_i + M_CO_2_i + M_NO_x_i)$$

где M_пыль_i, M_CO_2_i, M_NO_x_i — массы пыли, диоксида углерода и оксидов азота, образующихся на i-м технологическом переделе (буровзрывные работы, погрузочно-транспортные операции, дробление и сортировка).

Для каждого технологического передела удельные показатели выбросов определялись на основе данных производственного мониторинга, включающих замеры концентраций загрязняющих веществ на характерных участках карьера, а также паспортные характеристики применяемого оборудования (буровых станков, экскаваторов, автосамосвалов, дробильно-сортировочных установок).

3.3. Модель дисперсии пылевых загрязнений

Для описания динамики распространения пылевых частиц в воздушной среде карьера применена одномерная диффузионная модель, учитывающая процессы поступления пыли от источника и её осаждение (пылеподавление):

$dC/dt = M_ucm / V - k \cdot C$

где C — концентрация пыли в воздухе рабочей зоны, M_ист — интенсивность поступления пыли от источника выбросов, V — объём воздуха в рассматриваемой зоне карьера, k — эмпирический коэффициент, характеризующий совокупную эффективность естественного осаждения и применяемых средств пылеподавления.

Данная модель позволяет описывать как стационарные режимы работы карьера (при постоянной интенсивности источника), так и переходные процессы, связанные с включением/отключением оросительных установок и изменением интенсивности буровзрывных работ. Решение уравнения при постоянных M_ист и k имеет вид экспоненциального приближения концентрации C к стационарному значению C_ст = M_ист / (V·k), что позволяет прогнозировать время достижения предельно допустимых концентраций (ПДК) при различных сценариях эксплуатации пылеподавляющего оборудования.

3.4. Оценка эффективности внедряемых решений

Для количественной оценки эффективности предложенных технологических решений использован показатель относительного снижения массы выбросов:

$\Delta M = (M_до - M_после) / M_до \times 100\%$

где M_до и M_после — суммарная масса выбросов до и после внедрения комплекса природоохранных мероприятий соответственно.

3.5. Источники данных

Для практической части исследования использованы данные производственного экологического мониторинга карьера «Ёшлик-1» за отчётный период, включающие показатели пылевых и газовых выбросов по основным технологическим переделам, сведения о производительности горнотранспортного и дробильно-сортировочного оборудования, а также данные об эффективности эксплуатируемых средств пылеподавления. Анализ выполнен с применением аналитических и расчётно-экспериментальных методов, а также методов сравнительного анализа технологических альтернатив.

Результаты и обсуждение

4.1. Структура источников вредных выбросов

Проведённый анализ показал существенную неравномерность вклада различных технологических процессов в общий объём загрязнения атмосферы карьера «Ёшлик-1». Наибольший вклад — до 60% суммарных выбросов — вносит транспортно-погрузочный цикл, что обусловлено значительной

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протяжённостью транспортных коммуникаций, интенсивным движением большегрузного автотранспорта и связанным с этим вторичным пылением поверхности технологических дорог. Буровзрывные работы формируют до 25% пылевых и газовых загрязнений — данный вклад связан преимущественно с кратковременными, но интенсивными выбросами пыли и оксидов азота непосредственно в момент производства взрыва. На процессы дробления и сортировки приходится около 15% суммарных выбросов, что объясняется относительно локализованным характером данных операций и наличием базовых систем аспирации на существующем оборудовании.

Детализированные показатели выбросов по основным источникам представлены в Таблице 1.

Таблица 1. Основные результаты оценки выбросов на карьере «Ёшлик-1»

Источник выбросов	Пыль, кг/ч	CO_2, кг/ч	NO_x, кг/ч
Буровзрывные работы	85	45	30
Погрузочно-транспортные операции	70	60	25
Дробление и сортировка	55	15	10
Всего	**210**	**120**	**65**

Полученное распределение выбросов согласуется с общими закономерностями, характерными для карьеров аналогичного масштаба, и подтверждает приоритетность транспортно-погрузочного цикла как основного объекта для внедрения природоохранных мероприятий.

4.2. Комплекс предложенных технологических решений

На основании результатов анализа для карьера «Ёшлик-1» была разработана и предложена система комплексного пылеподавления, включающая три взаимодополняющих направления:

- Автоматические оросительные установки, обеспечивающие адресное увлажнение технологических дорог и рабочих площадок в зависимости от текущей метеорологической обстановки и интенсивности движения транспорта, что позволяет минимизировать вторичное пыление при одновременной экономии водных ресурсов.
- Герметизация дробильно-сортировочного оборудования с установкой дополнительных систем аспирации, снижающих выброс пыли непосредственно в местах перегрузки и измельчения горной массы.
- Использование электросамосвалов взамен части парка традиционной дизельной техники, что позволяет напрямую сократить

выбросы CO_2 и NO_x, образующиеся при сжигании дизельного топлива, а также снизить уровень шумового загрязнения на территории карьера.

4.3. Оценка эффективности внедрённых решений

Расчёт по формуле ΔM = (M_до − M_после) / M_до × 100% показал, что внедрение предложенного комплекса решений обеспечивает общее снижение загрязнений атмосферы на 35–40%. Одновременно с экологическим эффектом зафиксирован рост производительности горных работ, что объясняется сокращением простоев техники, связанных с ограничениями видимости при высокой запылённости, а также повышением надёжности эксплуатации дробильно-сортировочного оборудования после его герметизации.

Полученные результаты свидетельствуют о том, что природоохранные и производственные показатели при открытой разработке месторождений не являются взаимоисключающими: грамотно спроектированный комплекс технологических решений позволяет одновременно достигать снижения экологической нагрузки и повышения экономической эффективности производства. Данный вывод согласуется с современными представлениями об устойчивом горном деле, рассматривающем экологическую и производственную эффективность как взаимодополняющие, а не конкурирующие цели.

4.4. Обсуждение ограничений исследования

Следует отметить ряд ограничений, которые необходимо учитывать при интерпретации полученных результатов. Во-первых, представленные показатели эффективности отражают условия конкретного объекта — карьера «Ёшлик-1» — и могут варьироваться при переносе на предприятия с иными горно-геологическими и климатическими условиями. Во-вторых, применённая диффузионная модель является упрощённой одномерной аппроксимацией реальных процессов распространения загрязняющих веществ в атмосфере карьера, что обуславливает необходимость дальнейшего уточнения модели с учётом трёхмерной структуры воздушных потоков в карьерной выемке. В-третьих, оценка экономической эффективности внедрения электрифицированного транспорта требует отдельного детального технико-экономического анализа с учётом капитальных затрат на создание зарядной инфраструктуры.

Практическая значимость

Предложенные технологические решения имеют непосредственное практическое значение для горнодобывающих предприятий, эксплуатирующих месторождения открытым способом. Применение электрифицированного транспорта и автоматизированных оросительных

систем не только снижает вредные выбросы в атмосферу, но и способствует сокращению эксплуатационных затрат предприятия за счёт более низкой стоимости электроэнергии по сравнению с дизельным топливом, а также за счёт снижения затрат на техническое обслуживание электропривода.

Результаты исследования могут быть использованы:

- при проектировании новых карьеров с учётом требований современных экологических нормативов на стадии разработки проектной документации;
- при модернизации действующих горнодобывающих предприятий Узбекистана и стран Центральной Азии в рамках программ повышения экологической устойчивости производства;
- при разработке отраслевых методических рекомендаций по расчёту и нормированию вредных выбросов на карьерах;
- в качестве основы для дальнейших исследований, направленных на цифровизацию систем мониторинга и автоматизированное управление пылеподавляющим оборудованием в реальном времени.

Кроме того, повышение устойчивости предприятия к ужесточающимся экологическим требованиям способствует укреплению его репутации, снижению рисков штрафных санкций и облегчению доступа к международному финансированию, всё чаще обуславливаемому соответствием принципам экологической, социальной и корпоративной ответственности (ESG).

Заключение

Проведённое исследование подтвердило, что внедрение комплекса инновационных технологических решений на карьере «Ёшлик-1» способствует значительному улучшению как экологических, так и производственных показателей предприятия. Разработанная методика расчёта выбросов, основанная на балансовом подходе и диффузионной модели распространения пылевых загрязнений, позволяет объективно оценивать вклад отдельных технологических процессов в общий уровень загрязнения атмосферы карьера и обосновывать приоритетные направления природоохранных мероприятий.

Предложенная система комплексного пылеподавления, включающая автоматические оросительные установки, герметизацию дробильно-сортировочного оборудования и внедрение электросамосвалов, обеспечивает снижение концентрации загрязняющих веществ в рабочей зоне на 35–40% при одновременном росте производительности горных работ. Полученные

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результаты демонстрируют, что цели экологической безопасности и производственной эффективности при открытой разработке месторождений могут быть достигнуты совместно при условии комплексного, а не изолированного, подхода к выбору технологических решений.

Результаты работы могут служить методологической основой для внедрения комплексных программ по охране атмосферного воздуха и повышению безопасности труда на открытых горных разработках Узбекистана и других стран региона. Направлениями дальнейших исследований представляются уточнение трёхмерной модели дисперсии загрязняющих веществ с учётом рельефа карьерной выемки, а также детальный технико-экономический анализ полномасштабной электрификации карьерного транспорта.

Рекомендации по дальнейшему развитию исследований

Полученные в настоящей работе результаты открывают несколько перспективных направлений для дальнейших исследований в области снижения экологической нагрузки при открытой разработке рудных месторождений.

Во-первых, целесообразна разработка трёхмерной диффузионной модели распространения пылевых загрязнений, учитывающей реальную геометрию карьерной выемки, характер рельефа бортов карьера и сезонную изменчивость ветрового режима. Такая модель позволила бы более точно прогнозировать зоны повышенной концентрации загрязняющих веществ и оптимизировать размещение стационарных постов экологического мониторинга.

Во-вторых, перспективным направлением является интеграция систем автоматического контроля выбросов с системами управления горнотранспортным комплексом в режиме реального времени. Подобная интеграция позволила бы автоматически корректировать интенсивность работы оросительных установок в зависимости от текущей метеорологической обстановки и графика движения транспорта, что дополнительно повысило бы эффективность пылеподавления при сохранении экономии водных и энергетических ресурсов.

В-третьих, требует отдельного изучения вопрос масштабирования электрификации карьерного транспорта — от частичной замены дизельных самосвалов электрифицированными аналогами до создания полностью электрифицированного горнотранспортного комплекса. Экономическая целесообразность подобного перехода зависит от множества факторов, включая стоимость создания зарядной инфраструктуры, доступность электроэнергии на месторождении и динамику цен на дизельное топливо, что

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делает необходимым проведение комплексного технико-экономического анализа применительно к конкретным условиям каждого предприятия.

Наконец, представляется целесообразным распространение предложенной методологии оценки эффективности природоохранных мероприятий на другие крупные карьеры Центральной Азии с целью формирования сравнительной базы данных, позволяющей выявлять наиболее эффективные комбинации технологических решений для различных горно-геологических и климатических условий региона.

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АНАЛИЗ МЕТОДОВ ОБЕСПЕЧЕНИЯ БЕЗОПАСНЫХ УСЛОВИЙ ВЫЕМКИ РУДЫ ОТКРЫТЫМ СПОСОБОМ

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Аннотация. *В работе рассмотрены основные технические, технологические и организационные методы обеспечения безопасности при разработке рудных месторождений открытым способом. Выделены ключевые факторы риска: потеря устойчивости бортов и уступов, опасные последствия буровзрывных работ, запылённость и загазованность карьерного пространства, аварийность карьерного транспорта и обводнённость горных выработок. Проведён сравнительный анализ методов контроля и предупреждения этих рисков. Показано, что наибольшая эффективность достигается при комплексном подходе, сочетающем геомеханический мониторинг, цифровые технологии, совершенствование параметров взрывных работ и систему управления профессиональными рисками.*

Ключевые слова: *открытые горные работы, промышленная безопасность, устойчивость бортов карьера, буровзрывные работы, геомеханический мониторинг, управление рисками, цифровизация.*

Abstract. *The paper examines the main technical, technological, and organizational methods for ensuring safety in open-pit mining of ore deposits. The key risk factors are identified: loss of stability of pit walls and benches, hazardous consequences of drilling and blasting operations, dust and gas contamination of the open-pit workspace, accidents involving mining transport, and water inundation of mine workings. A comparative analysis of control and prevention methods for these risks is conducted. It is shown that the highest efficiency is achieved through an integrated approach combining geomechanical monitoring, digital technologies, optimization of blasting parameters, and an occupational risk management system.*

Keywords: *open-pit mining, industrial safety, pit wall stability, drilling and blasting operations, geomechanical monitoring, risk management, digitalization.*

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Введение. *Открытый способ добычи остаётся основным для большинства рудных месторождений благодаря высокой производительности и меньшей себестоимости. Однако рост глубины карьеров, увеличение объёмов горной массы и применение крупногабаритной техники повышают вероятность аварий и несчастных случаев. Обеспечение безопасных условий выемки руды является ключевым условием устойчивого развития горнодобывающих предприятий.*

Цель работы *— анализ существующих методов обеспечения безопасности при открытой разработке рудных месторождений и определение направлений их совершенствования.*

Основная часть

1. Обеспечение устойчивости бортов и уступов. Главным риском глубоких карьеров являются обрушения и оползни. Применяются инженерно-геологические изыскания, расчёты устойчивости (методы предельного равновесия, численное моделирование), оптимизация углов откосов и параметров уступов, а также укрепление бортов (разгрузка, анкерование, дренаж). Современный подход включает мониторинг деформаций с помощью наземных радаров, лазерного сканирования, GNSS и съёмки с БПЛА, что позволяет прогнозировать смещения и вовремя эвакуировать технику и людей.

2. Безопасность буровзрывных работ. Основные опасности: разлёт кусков породы, сейсмическое воздействие, воздушная ударная волна и выделение ядовитых газов. Для их снижения используются расчёт радиусов опасных зон, электронные системы инициирования с точной замедлительной схемой, контурное взрывание, мониторинг сейсмических колебаний и применение эмульсионных ВВ с контролируемым составом.

3. Борьба с пылью и газами. В глубоких карьерах возможно образование застойных зон загрязнённого воздуха. Эффективны орошение и гидрообеспыливание, пылеподавляющие реагенты на дорогах, пылеулавливание при бурении, искусственное проветривание, а также учёт метеоусловий при планировании взрывов.

Таблица 1.1 — Сравнительные горно-технические параметры крупнейших медно-порфировых карьеров мира

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Месторождение / Карьер	Страна	Годовая мощность по руде (млн т)	Проектная глубина (м)	Преобладающий транспорт
Бингем-Каньон (Bingham)	США	55	1200	Автомобильный + Конвейерный
Чукикамата (Chuquicamata)	Чили	90	1100	Комбинированный (Авто+Шахта)
Эскондида (Escondida)	Чили	120	650	Автомобильный
Ёшлик-1 (АГМК)	Узбекистан	60 – 100	550	Комбинированный (Авто+Ж/Д+КТ)

4. Безопасность карьерного транспорта. Значительная часть происшествий связана с эксплуатацией большегрузных самосвалов. Меры включают правильное проектирование автодорог (уклоны, ширина, защитные валы), системы предупреждения столкновений, диспетчеризацию, контроль усталости и состояния водителей, регламентированное техническое обслуживание.

5. Водоотлив и осушение. Обводнённость снижает устойчивость бортов и осложняет работы. Применяются нагорные канавы, дренажные скважины и штольни, системы карьерного водоотлива.

6. Организационные и цифровые методы. Важную роль играют системы управления охраной труда (например, на основе ISO 45001), оценка и ранжирование рисков, обучение и аттестация персонала, расследование инцидентов. Перспективными направлениями являются цифровые двойники карьера, автоматизация и дистанционное управление техникой, применение искусственного интеллекта для прогнозирования опасных ситуаций.

Выводы

- Безопасность открытых горных работ определяется совокупностью факторов, поэтому отдельные меры недостаточно эффективны без системного подхода.
- Приоритетными направлениями являются непрерывный геомеханический мониторинг и прогнозирование деформаций бортов.
- Совершенствование технологии буровзрывных работ и транспортных процессов существенно снижает травматизм и аварийность.

- Внедрение цифровых технологий и риск-ориентированного управления позволяет перейти от реагирования на происшествия к их предупреждению.

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СОВРЕМЕННЫЕ ИННОВАЦИИ В ХИМИЧЕСКОЙ ПРОМЫШЛЕННОСТИ И ПЕРСПЕКТИВЫ ИХ РАЗВИТИЯ

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Аннотация. *В тезисе рассматриваются ключевые направления технологического обновления химической промышленности: цифровизация производства, развитие каталитических процессов, применение новых материалов, внедрение принципов «зелёной химии» и использование возобновляемого сырья. Обобщены преимущества инноваций и основные условия их эффективного внедрения. Отмечено, что сочетание ресурсосбережения, экологической безопасности и цифрового управления является важным условием конкурентоспособности химических предприятий.*

Ключевые слова: *химическая промышленность, инновационные технологии, зелёная химия, цифровизация, катализ, наноматериалы, ресурсосбережение, устойчивое развитие.*

Annotatsiya. *Ushbu tezisda kimyo sanoatini texnologik yangilashning asosiy yo‘nalishlari: ishlab chiqarishni raqamlashtirish, katalitik jarayonlarni rivojlantirish, yangi materiallardan foydalanish, «yashil kimyo» tamoyillarini joriy etish va qayta tiklanuvchi xomashyodan foydalanish ko‘rib chiqiladi. Innovatsiyalarning afzalliklari hamda ularni samarali joriy etish shartlari umumlashtiriladi. Resurslarni tejash, ekologik xavfsizlik va raqamli boshqaruvning uyg‘unligi kimyo korxonalari raqobatbardoshligining muhim omili ekani ta’kidlanadi.*

Kalit so‘zlar: *kimyo sanoati, innovatsion texnologiyalar, yashil kimyo, raqamlashtirish, kataliz, nanomateriallar, resurslarni tejash, barqaror rivojlanish*

Abstract. *This thesis examines the main directions of technological modernization in the chemical industry: production digitalization, the development of catalytic processes, the use of new materials, the implementation of green chemistry principles, and the use of renewable feedstocks. It summarizes the benefits of innovation and the key conditions for its effective implementation. The combination of resource efficiency, environmental safety, and digital management is identified as an important factor in the competitiveness of chemical enterprises.*

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Keywords: *chemical industry, innovative technologies, green chemistry, digitalization, catalysis, nanomaterials, resource efficiency, sustainable development.*

Актуальность. Химическая промышленность занимает важное место в современной экономике, поскольку обеспечивает материалами и веществами практически все основные отрасли: медицину, фармацевтику, сельское хозяйство, энергетику, строительство, транспорт и производство потребительских товаров. Одновременно химическое производство связано с высоким потреблением энергии и сырья, образованием отходов и потенциальным воздействием на окружающую среду. Поэтому дальнейшее развитие отрасли невозможно без внедрения инноваций, направленных не только на увеличение объёмов выпуска, но и на повышение эффективности, безопасности и экологичности производственных процессов.

Цель исследования — рассмотреть современные инновационные решения в химической промышленности, определить их значение для повышения эффективности производства и обозначить перспективы дальнейшего технологического развития.

Материалы и методы. Работа основана на анализе научной и учебной литературы, международных материалов по устойчивому промышленному развитию и публикаций, посвящённых современным химическим технологиям. Использованы методы обобщения, сравнения и систематизации информации.

Основные направления инновационного развития. Одним из наиболее заметных направлений является цифровизация химических предприятий. Датчики, автоматизированные системы контроля, математическое моделирование и технологии искусственного интеллекта позволяют в режиме реального времени отслеживать параметры технологических процессов. Это помогает своевременно выявлять отклонения, повышать стабильность качества продукции, сокращать простои оборудования и рациональнее расходовать сырьё и энергию. Цифровые модели производственных установок также дают возможность оценивать различные режимы работы без проведения большого количества дорогостоящих физических испытаний.

Важную роль играет совершенствование каталитических технологий. Катализаторы ускоряют химические реакции и позволяют проводить их при более низких температурах и давлениях, что может уменьшать энергозатраты и количество побочных продуктов. Исследования в области

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наноструктурированных и высокоселективных катализаторов открывают возможности для более эффективного получения полимеров, удобрений, лекарственных субстанций и других химических продуктов. При этом существенное значение имеют срок службы катализатора, доступность исходных компонентов и возможность его повторного использования.

Отдельное место занимает концепция «зелёной химии», предполагающая предупреждение загрязнения на этапе проектирования химических процессов. Её принципы включают снижение образования отходов, применение менее опасных реагентов и растворителей, повышение энергоэффективности, использование возобновляемого сырья и разработку продуктов, которые оказывают меньшую нагрузку на окружающую среду. В перспективе это способствует переходу от модели «произвести — использовать — выбросить» к более рациональному обращению с материалами.

Перспективным направлением является использование биомассы и других возобновляемых ресурсов в качестве альтернативы части ископаемого сырья. Биотехнологические методы, ферментативные реакции и биокатализ могут применяться для получения органических кислот, биополимеров, растворителей и промежуточных продуктов химического синтеза. Такие решения способны уменьшать зависимость от невозобновляемых ресурсов, однако их промышленное внедрение требует оценки доступности сырья, расхода воды и энергии, а также полного жизненного цикла продукции.

Развитие новых функциональных материалов также расширяет возможности отрасли. Композитные материалы, мембраны, сорбенты и наноматериалы находят применение в очистке воды и газов, медицине, электронике и энергетике. Например, современные мембранные технологии позволяют разделять смеси и очищать технологические потоки с потенциально меньшими энергозатратами по сравнению с некоторыми традиционными методами. Вместе с тем безопасность наноматериалов, их воздействие на здоровье человека и поведение после использования должны оцениваться на всех этапах жизненного цикла.

Результаты и обсуждение. Проведённый анализ показывает, что отдельные инновации дают наибольший эффект при комплексном внедрении. Цифровой мониторинг помогает управлять ресурсосберегающими процессами, современные катализаторы повышают селективность реакций, а принципы зелёной химии позволяют учитывать экологические последствия уже на стадии разработки технологии. Для оценки эффективности инноваций целесообразно использовать не только показатели производительности и себестоимости, но и объём выбросов, количество отходов, расход воды и

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энергии, безопасность труда и возможность повторного использования материалов.

При этом переход к инновационной модели сопровождается определёнными трудностями. К ним относятся высокая стоимость модернизации оборудования, необходимость подготовки квалифицированных специалистов, недостаточная доступность отдельных видов сырья и технологий, а также потребность в надёжной системе экологического контроля. Следовательно, успешное развитие отрасли требует взаимодействия научных организаций, образовательных учреждений, промышленных предприятий и государственных структур.

Заключение. Современные инновации являются важнейшим фактором повышения эффективности и устойчивости химической промышленности. Наиболее перспективными направлениями выступают цифровизация производственных процессов, разработка эффективных катализаторов, применение возобновляемого сырья, создание новых функциональных материалов и внедрение принципов зелёной химии. Их комплексное использование позволяет улучшать качество продукции, рационально расходовать ресурсы и снижать экологическую нагрузку. Дальнейшее развитие отрасли будет зависеть от научных исследований, технологических инвестиций, подготовки специалистов и последовательного внедрения экологически ответственных решений.

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A REGRESSION-BASED DECISION SUPPORT MODEL FOR PRODUCT PRICE ESTIMATION

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Abstract. *Accurate product price estimation is an important task in retail management, e-commerce, and data-driven decision-making. Product prices are influenced by multiple factors, including product characteristics, brand, quality, market conditions, and competitive environment. Traditional pricing decisions based primarily on subjective judgment may not sufficiently reflect the relationships among these factors. This study proposes a regression-based decision support model for product price estimation. The proposed approach applies multiple linear regression to examine the relationship between product attributes and observed market prices. The methodology includes data collection, preprocessing, variable selection, model development, statistical evaluation, and interpretation of estimated prices. The model is designed to provide quantitative information that can support pricing decisions. The study also discusses the importance of model diagnostics and the limitations associated with linear assumptions, data quality, and market variability. The proposed framework can serve as a foundation for developing a practical analytical tool for product price estimation.*

Keywords*: product price estimation, multiple linear regression, regression analysis, decision support model, product attributes, pricing analytics.*

Аннотация. *Точная оценка цен на продукцию является важной задачей в управлении розничной торговлей, электронной коммерции и принятии решений на основе данных. На цены продукции влияют различные факторы, включая характеристики товара, бренд, качество, рыночные условия и конкурентную среду. Традиционные подходы к ценообразованию, основанные преимущественно на субъективных оценках, не всегда позволяют в полной мере учитывать взаимосвязи между этими факторами. В данном исследовании предлагается модель поддержки принятия решений для оценки цен на продукцию на основе регрессионного анализа. Предлагаемый подход использует множественную линейную регрессию для изучения взаимосвязи между характеристиками товаров и наблюдаемыми рыночными ценами.*

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Методология включает сбор и предварительную обработку данных, отбор переменных, построение модели, статистическую оценку и интерпретацию полученных результатов. Модель предназначена для предоставления количественной информации, способствующей обоснованному принятию решений в области ценообразования. В исследовании также рассматриваются важность диагностики модели и ограничения, связанные с предположениями линейности, качеством данных и изменчивостью рыночных условий. Предлагаемая модель может служить основой для разработки практического аналитического инструмента оценки цен на продукцию.

Ключевые слова: *оценка цен на продукцию, множественная линейная регрессия, регрессионный анализ, модель поддержки принятия решений, характеристики продукции, аналитика ценообразования.*

Annotatsiya. *Mahsulot narxlarini aniq baholash chakana savdoni boshqarish, elektron tijorat va ma’lumotlarga asoslangan qarorlar qabul qilishda muhim vazifa hisoblanadi. Mahsulot narxlariga uning xususiyatlari, brendi, sifati, bozor sharoitlari va raqobat muhiti kabi ko‘plab omillar ta’sir ko‘rsatadi. Asosan subyektiv baholashga asoslangan an’anaviy narx belgilash usullari ushbu omillar o‘rtasidagi bog‘liqliklarni har doim ham yetarli darajada aks ettira olmaydi. Mazkur tadqiqotda mahsulot narxlarini baholash uchun regressiya tahliliga asoslangan qarorlarni qo‘llab-quvvatlash modeli taklif etiladi. Taklif etilgan yondashuv mahsulot xususiyatlari va kuzatilgan bozor narxlari o‘rtasidagi bog‘liqlikni o‘rganishda ko‘p omilli chiziqli regressiya usulidan foydalanadi. Tadqiqot metodologiyasi ma’lumotlarni yig‘ish, dastlabki qayta ishlash, o‘zgaruvchilarni tanlash, modelni ishlab chiqish, statistik baholash va olingan natijalarni sharhlash bosqichlarini o‘z ichiga oladi. Model narx belgilash bo‘yicha asoslangan qarorlar qabul qilishga yordam beradigan miqdoriy ma’lumotlarni taqdim etishga mo‘ljallangan. Shuningdek, tadqiqotda model diagnostikasining ahamiyati hamda chiziqlilik farazlari, ma’lumotlar sifati va bozor o‘zgaruvchanligi bilan bog‘liq cheklovlar ko‘rib chiqiladi. Taklif etilgan yondashuv mahsulot narxlarini baholash uchun amaliy tahliliy vositani ishlab chiqishga asos bo‘lib xizmat qilishi mumkin.*

Kalit so‘zlar: *mahsulot narxini baholash, ko‘p omilli chiziqli regressiya, regressiya tahlili, qarorlarni qo‘llab-quvvatlash modeli, mahsulot xususiyatlari, narx belgilash tahlili.*

Introduction

Product pricing is a fundamental activity in retail, e-commerce, and business management. The price of a product is generally influenced by a combination of product-specific, market-related, and competitive factors. These factors may include product quality, brand reputation, technical specifications, production costs, consumer demand, and competitor prices. Because these variables interact with one another, determining an appropriate product price is a multidimensional analytical problem.

In many business environments, pricing decisions are made using historical experience, market observation, and managerial judgment. Although these approaches may be useful, they do not always provide a consistent quantitative explanation of how individual factors influence product prices. Consequently, statistical and data-driven methods have become important tools for identifying relationships between explanatory variables and pricing outcomes.

Regression analysis is one of the widely used statistical approaches for estimating relationships between a dependent variable and one or more independent variables. In particular, multiple linear regression allows the effect of several explanatory variables on a target variable to be examined simultaneously. This makes it suitable for product price estimation, where the observed price may depend on several measurable product and market characteristics.

The methodological foundation of this study is related to the work of Aravinth et al. [1], who investigated a regression-based decision support approach for extracting relationships between variables and forecasting new observations. Their study followed a phased process involving data preprocessing, model fitting, testing, prediction, and visualization. Although their application focused on employee salary prediction rather than product pricing, the general workflow demonstrates how regression analysis can be incorporated into a decision support context.

Building on this general analytical approach, the present study considers product price as the dependent variable and product or market characteristics as explanatory variables. The purpose is not only to estimate prices but also to provide interpretable information that can assist pricing-related decisions.

Materials and Methods

This study adopts a quantitative research approach to develop a regression-based decision support model for product price estimation. The proposed methodology is designed to identify the relationship between product characteristics, market-related factors, and observed product prices, and to transform these relationships into an analytical tool that can support pricing decisions. The methodological foundation is related to the regression-based decision support workflow described by Aravinth et al. [1], which involves data preprocessing, model

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development, testing, prediction, and visualization. In the present study, this general workflow is adapted to the context of product price estimation.

The empirical analysis is intended to use a structured dataset containing product observations, their measurable characteristics, and corresponding market prices. To ensure comparability between observations, the study should focus on a specific product category, such as smartphones, laptops, or household appliances. The selection of the product category will depend on the availability, completeness, and reliability of the collected data. Each observation should represent an individual product or a specific product model, while the dependent variable will be its observed market price. The independent variables will describe the characteristics that may explain differences in product prices. Depending on the selected category, these variables may include brand, product quality, technical specifications, product age, storage capacity, processor characteristics, battery capacity, display features, market demand, and competitor prices. Variables that cannot be measured consistently or that contain a substantial number of missing observations will be excluded or treated using an appropriate preprocessing procedure.

The data preparation stage will include the identification and removal of duplicate records, examination of missing values, correction of inconsistent units, and detection of potentially erroneous observations. Numerical variables will be converted into a consistent format, while categorical variables, such as brand or product type, will be transformed into numerical representations using an appropriate encoding method. Where necessary, numerical features may be standardized to facilitate comparison between variables with different measurement scales. However, standardization will not be treated as a substitute for economic interpretation, since the meaning of each variable must remain clear. Outliers will be examined carefully because unusually high or low prices may represent either data errors or genuine market observations. Such observations will not be removed automatically; their treatment will depend on their source and their influence on the estimated model.

The principal analytical method will be multiple linear regression. This method is selected because it allows the simultaneous examination of the relationship between a dependent variable and several explanatory variables. In the proposed model, product price is considered the dependent variable, while product and market characteristics are treated as independent variables. The general form of the model is expressed as:

$$P_i=\beta_0+\beta_1X_{1i}+\beta_2X_{2i}+\cdots+\beta_kX_{ki}+\varepsilon_i$$

where P_i denotes the observed price of product i, β_0 represents the intercept, X_{1i}, $X_{2i,\ \ldots,}$ X_{ki} are the explanatory variables β_1, $\beta_{2,}$ …, β_k are the corresponding regression

coefficients, and ε_i is the error term. After estimating the model parameters, the predicted price of a product can be calculated using:

$$\widehat{P_i}=\widehat{\beta_0}+\widehat{\beta_1}X_{1i}+\widehat{\beta_2}X_{2i}+\cdots+\widehat{\beta_k}X_{ki}$$

The coefficients will be interpreted according to the measurement scale and coding of the corresponding variables. A positive coefficient indicates a positive conditional association between an explanatory variable and the estimated price, whereas a negative coefficient indicates a negative conditional association, assuming that the other variables in the model remain constant. Such interpretations will be made cautiously, because statistical association does not necessarily establish a causal relationship.

The model development process will involve selecting relevant explanatory variables, estimating the regression coefficients, and evaluating the statistical significance of the model. Variable selection may be guided by previous literature, economic reasoning, correlation analysis, and multicollinearity diagnostics. The significance of individual coefficients may be examined using t-tests and p-values, while the overall significance of the regression model may be assessed using an F-test. The coefficient of determination (R^2) and adjusted R^2 will be used to evaluate how much variation in observed product prices is explained by the selected variables. Adjusted R^2 is particularly relevant when models contain different numbers of explanatory variables because it accounts for model complexity.

To evaluate predictive performance, the dataset may be divided into training and testing subsets. The training subset will be used to estimate the regression model, while the testing subset will be used to assess its performance on previously unseen observations. The evaluation will use the Root Mean Square Error (RMSE) and Mean Absolute Error (MAE). RMSE is calculated as:

$$\text{RMSE} = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(P_i-\widehat{P_i})^2}$$

whereas MAE is defined as:

$$\text{MAE}=\frac{1}{n}\sum_{i=1}^{n}|P_i-\widehat{P_i}|$$

These measures will provide complementary information about the magnitude of prediction errors. RMSE gives greater weight to larger errors, while MAE expresses the average absolute prediction error in the same unit as the dependent variable. Where the dataset size permits, cross-validation may also be applied to obtain a more robust estimate of model generalization.

In addition to predictive evaluation, the assumptions of multiple linear regression will be examined. Residual analysis will be conducted to identify systematic patterns in prediction errors. Multicollinearity will be assessed using correlation analysis and the Variance Inflation Factor (VIF), since highly correlated

explanatory variables may reduce the stability and interpretability of regression coefficients. Heteroscedasticity will also be considered because non-constant error variance can affect the reliability of statistical inference. Influential observations will be examined to determine whether individual records disproportionately affect the estimated model. These diagnostic procedures are important for ensuring that the proposed model is not evaluated solely on the basis of its goodness-of-fit.

The final stage of the methodology will involve integrating the regression results into a conceptual decision support framework. The model will accept product characteristics as input and generate an estimated market price as output. In addition to the estimated price, the system may present relevant explanatory variables, model performance indicators, and the difference between observed and estimated prices. This information can support pricing analysis, product comparison, and the evaluation of alternative pricing decisions. The proposed model is intended to assist decision-makers rather than replace managerial judgment, as actual market prices may also be affected by temporary promotions, supply conditions, consumer preferences, and other factors not included in the dataset. Thus, the reliability of the decision support model will depend on the quality of the data, the appropriateness of the selected variables, and the validity of the statistical assumptions.

Results and Discussion

The proposed regression-based decision support model is expected to provide a systematic and transparent approach to estimating product prices based on observable product characteristics. By using multiple linear regression, the model can identify the relationship between product price and explanatory variables such as brand, technical specifications, product quality, age, storage capacity, processor performance, battery capacity, and competitor prices. The estimated coefficients indicate the expected contribution of each variable to the final price while keeping other variables constant. For example, technical specifications and brand reputation may demonstrate a positive relationship with product price, whereas product age may have a negative effect because older products generally lose market value over time. Competitor prices and market demand may also influence the estimated price by reflecting current market conditions.

The model's performance can be evaluated using the coefficient of determination (R^2), adjusted R^2, mean absolute error (MAE), and root mean square error (RMSE). A higher R^2 value indicates that a larger proportion of price variation is explained by the selected predictors, while lower MAE and RMSE values demonstrate more accurate price estimations. However, a high R^2 value alone does not necessarily guarantee reliable predictions, because the model may be affected by multicollinearity, outliers, or overfitting. Therefore, residual analysis and variance

inflation factor testing should be used to verify the statistical reliability of the model. If the residuals are distributed without clear patterns, the model can be considered more appropriate for price estimation.

From a decision-support perspective, the model can assist sellers, retailers, and managers in determining a reasonable price range for a product. The comparison between the observed market price and the estimated price can reveal whether a product is potentially overpriced or underpriced. For instance, when the observed price is considerably higher than the estimated price, the seller may need to justify the difference through additional product quality, warranty, brand value, or service benefits. Conversely, when the observed price is lower than the estimated value, the product may represent a competitive opportunity. Nevertheless, the regression model should not be interpreted as a complete replacement for managerial judgment. Product prices are also affected by factors that may be difficult to quantify, including consumer preferences, promotional campaigns, seasonal changes, economic conditions, and sudden market fluctuations. Consequently, the proposed model should be used as an analytical support tool that combines statistical estimation with expert interpretation and current market information. Overall, the model offers an explainable and practical foundation for product price estimation and can be further improved through larger datasets, nonlinear regression methods, machine learning algorithms, and real-time market data integration.

Conclusion

This study proposed a regression-based decision support model for product price estimation. The framework applies multiple linear regression to examine the relationship between product characteristics, market factors, and observed prices. The proposed methodology includes data preprocessing, variable selection, model development, statistical evaluation, and interpretation of estimated prices.

The main contribution of the proposed approach is the integration of regression-based price estimation with a decision-support perspective. Rather than treating regression solely as a prediction technique, the framework emphasizes the interpretation of relationships between variables and the practical use of model outputs in pricing analysis.

The next stage of the research will involve selecting a specific product category, collecting a reliable dataset, estimating the regression coefficients, and evaluating the model using statistical and predictive metrics. The empirical results will determine the actual explanatory power, limitations, and practical applicability of the proposed model.

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THE GLOBAL AI RACE: WHICH COUNTRIES ARE LEADING AND WHY?

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Annotatsiya. *Mazkur tezisda sun’iy intellekt sohasida yetakchilik uchun olib borilayotgan global raqobat va unda ishtirok etayotgan mamlakatlarning strategik ustunliklari tahlil qilinadi. Xususan, AQSh va Xitoy o‘rtasidagi texnologik raqobat, sun’iy intellektga yo‘naltirilayotgan investitsiyalar, ilmiy tadqiqotlar, hisoblash infratuzilmasi va yuqori malakali mutaxassislar salohiyati ko‘rib chiqiladi. Shuningdek, Janubiy Koreya, Buyuk Britaniya, Singapur, Yaponiya va Yevropa davlatlarining global AI ekotizimidagi o‘rni yoritiladi. Tadqiqot sun’iy intellekt sohasidagi yetakchilikni faqat texnologik ishlanmalar bilan emas, balki iqtisodiy imkoniyatlar, sanoat infratuzilmasi, innovatsion salohiyat va davlat strategiyalari bilan ham baholash zarurligini yoritadi.*

Kalit so‘zlar: *sun’iy intellekt, global raqobat, AQSh, Xitoy, Janubiy Koreya, texnologik yetakchilik, innovatsiyalar, investitsiyalar, raqamli iqtisodiyot, AI infratuzilmasi.*

Аннотация. *В данном тезисе анализируется глобальная конкуренция за лидерство в сфере искусственного интеллекта и стратегические преимущества участвующих в ней государств. Особое внимание уделяется технологическому соперничеству между США и Китаем, инвестициям в искусственный интеллект, научным исследованиям, вычислительной инфраструктуре и человеческому капиталу. Также рассматривается роль Южной Кореи, Великобритании, Сингапура, Японии и европейских стран в формировании глобальной экосистемы искусственного интеллекта. Исследование обосновывает необходимость оценки лидерства в сфере ИИ не только по уровню технологических разработок, но и с учётом экономических возможностей, промышленной инфраструктуры, инновационного потенциала и государственных стратегий.*

Ключевые слова: *искусственный интеллект, глобальная конкуренция, США, Китай, Южная Корея, технологическое лидерство, инновации, инвестиции, цифровая экономика, инфраструктура ИИ.*

Abstract. *This thesis examines the global competition for leadership in artificial intelligence (AI) and the strategic advantages of the countries participating*

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in this race. Particular attention is given to technological competition between the United States and China, investment in AI, scientific research, computing infrastructure, and human capital. The study also explores the roles of South Korea, the United Kingdom, Singapore, Japan, and European countries in shaping the global AI ecosystem. It argues that leadership in artificial intelligence should not be measured solely by technological achievements but also by economic resources, industrial infrastructure, innovation capacity, and national development strategies. The analysis highlights the emergence of a multipolar AI ecosystem in which different countries demonstrate competitive advantages across various dimensions.

Keywords: *artificial intelligence, global competition, United States, China, South Korea, technological leadership, innovation, investment, digital economy, AI infrastructure.*

Introduction

Artificial intelligence has become one of the most strategically important technologies of the twenty-first century. Its rapid development is transforming economic structures, industrial production, international trade, scientific research, and national security. As a result, competition in AI is no longer limited to technology companies; it has become a major element of national economic and technological strategies.

Countries are competing to develop advanced AI models, build powerful computing infrastructure, attract highly qualified specialists, and establish leadership in semiconductor manufacturing. These capabilities are increasingly considered essential for long-term economic competitiveness.

The global AI race is primarily associated with the United States and China. However, other countries, including South Korea, the United Kingdom, Singapore, Japan, and members of the European Union, are developing their own strategies to strengthen their positions.

The purpose of this thesis is to analyse the current global AI competition, identify the competitive advantages of leading countries, and examine the economic and technological factors determining international AI leadership.

The United States: leadership in investment and AI infrastructure

The United States maintains a particularly strong position in the global AI ecosystem due to its technological companies, research institutions, venture capital market, and advanced computing infrastructure.

Companies such as OpenAI, Google, Microsoft, Anthropic, Meta, and NVIDIA play significant roles in the development of AI models, cloud computing, software platforms, and specialised semiconductor technologies.

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According to Stanford University's *AI Index Report 2026*, private AI investment in the United States reached approximately $285.9 billion in 2025, compared with $12.4 billion in China. The United States also hosts 5,427 data centres, representing a substantial concentration of global computing infrastructure (Stanford HAI, 2026).

Another important advantage is the country's ability to attract private investment and transform scientific research into commercial applications. Major technology companies are investing heavily in data centres, AI chips, cloud infrastructure, and large-scale computing systems.

However, American leadership also faces challenges, including high infrastructure costs, energy requirements, increasing international competition, and concerns about the concentration of advanced AI technologies.

China: a strong competitor in AI research and industrial applications

China has emerged as one of the most important competitors in the global AI race. Its strategy combines government support, industrial development, scientific research, and large-scale adoption of AI technologies.

Chinese technology companies such as Baidu, Alibaba, Tencent, Huawei, and DeepSeek contribute to the development of AI models, cloud computing, robotics, and semiconductor technologies.

One of China's major advantages is its extensive industrial base and ability to integrate AI into manufacturing, logistics, transportation, and other economic activities.

The Stanford AI Index Report 2026 indicates that China leads in AI publication volume, citations, overall patent output, and industrial robot installations. At the same time, American institutions continue to produce more top-tier AI models and higher-impact AI patents.

An important development is the rapid improvement of Chinese AI models. The emergence of DeepSeek demonstrated that competitive AI systems can be developed using alternative approaches to model training and computational resource optimisation.

Nevertheless, China faces restrictions in accessing certain advanced semiconductor technologies and manufacturing equipment. These limitations create challenges for the development of the most advanced AI computing infrastructure.

South Korea: semiconductors as a strategic advantage

South Korea occupies a distinctive position in the global AI race because of its strong semiconductor industry and advanced technological infrastructure.

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Companies such as Samsung Electronics and SK hynix are important global suppliers of memory semiconductors, particularly high-bandwidth memory (HBM), which is essential for modern AI accelerators and data centres.

South Korea's competitive advantage is not limited to semiconductor manufacturing. The country also has strong telecommunications infrastructure, advanced electronics manufacturing, research universities, and significant industrial investment.

According to the Stanford AI Index Report 2026, South Korea leads the world in AI patents per capita, demonstrating its innovation intensity relative to population size.

The 2026 Global AI Index also places South Korea among the leading national AI ecosystems, ranking it fifth overall.

However, South Korea faces several challenges, including competition for AI talent, dependence on international semiconductor supply chains, and the need to strengthen its domestic AI software and foundation model ecosystem.

The country's long-term competitiveness will depend on its ability to combine semiconductor manufacturing leadership with AI software development, research, and commercial applications.

Other important participants in the global AI race

Although the United States and China dominate much of the international discussion, several other countries are developing significant AI capabilities.

United Kingdom. The United Kingdom has an established AI research ecosystem, internationally recognised universities, and companies such as DeepMind. Its strengths include scientific research, AI development, and technology entrepreneurship.

Singapore. Singapore has developed a strong national AI strategy, supported by government investment, digital infrastructure, international partnerships, and an innovation-oriented business environment. Its small geographical size has not prevented it from becoming an important AI centre.

Japan. Japan's competitive advantages include robotics, industrial automation, electronics, and advanced manufacturing. Its AI development is closely connected with applications in industrial production, healthcare, and robotics.

European Union. European countries possess strong scientific institutions, engineering expertise, and industrial capabilities. France and Germany are particularly important in AI research and industrial applications. However, fragmented markets, comparatively lower private investment, and limited large-scale computing infrastructure create challenges for the region.

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India. India has a growing software industry, a large technology workforce, and an expanding digital economy. Its opportunities include AI services, software development, and the adoption of AI in public services and business operations.

Who is winning the global ai race?

Determining which country is winning the AI race requires considering several different indicators rather than relying on a single measure.

The 2026 Global AI Index, which evaluates national AI capabilities across multiple indicators, places the United States first, China second, the United Kingdom third, Singapore fourth, and South Korea fifth.

The Stanford AI Index 2026 also demonstrates that the United States and China have become highly competitive in advanced AI model development. By March 2026, the performance difference between the leading American and Chinese models had narrowed considerably, with the leading American model holding an advantage of only 2.7% according to the report's comparison.

The competitive landscape can therefore be understood through several dimensions:

Dimension	Countries with notable advantages
Private AI investment	United States
Advanced AI models	United States and China
AI research publications	China
AI patent output	China
AI patents per capita	South Korea
Data centre infrastructure	United States
Semiconductor memory	South Korea
Industrial robotics	China and Japan
AI research ecosystem	United States and United Kingdom

These comparisons demonstrate that AI leadership is distributed across different technological and economic areas. The United States has considerable advantages in capital, computing infrastructure, and leading AI companies, while China demonstrates strong capabilities in research output, patents, and industrial deployment. South Korea's semiconductor ecosystem and innovation intensity provide another important source of international competitiveness.

Consequently, the global AI race should be understood as a multidimensional competition rather than a contest with one definitive winner.

Conclusion

The global competition in artificial intelligence is reshaping international economic relations and technological development. The United States and China

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currently represent the two most influential national AI ecosystems, although their competitive advantages differ across investment, infrastructure, scientific research, and industrial applications.

South Korea, the United Kingdom, Singapore, Japan, and European economies also play important roles in the development of the global AI ecosystem. Their experiences demonstrate that countries can establish competitive positions by concentrating on specific technological strengths rather than attempting to dominate every aspect of AI development.

From an economic perspective, successful participation in the AI race requires more than investment in software companies. It also requires advanced semiconductor technologies, reliable energy infrastructure, research institutions, skilled human capital, and effective cooperation between governments and the private sector.

Ultimately, future AI leadership will depend on the ability of countries to integrate technological innovation with industrial development and sustainable economic strategies. The countries that successfully combine these elements will be better positioned to influence the future direction of the global digital economy.

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ACHIEVING ELECTRICAL ENERGY SAVINGS DURING TRANSIENT PROCESSES IN INDUCTION MOTOR DRIVES OF LOOMS AT TEXTILE ENTERPRISES

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At present, textile enterprises in our republic are undergoing continuous improvement. The textile industry itself comprises a complex and diverse range of branches, one of the largest of which is cotton fabric production. Alongside cotton fibre, the production of man-made fibres is also developing in the Republic of Uzbekistan. This makes it possible to further expand the raw material base of the textile industry in our independent republic and increase the range of manufactured products. For example, current surges occur during the operation of electric motors in looms and spinning machines at textile enterprises; this current is referred to as the starting current or locked-rotor current [2]. The starting current is 5–7 times the rated current and acts for a short period. Once the motor has accelerated, its current decreases to a minimum value [6]. Various starting methods are used to reduce the starting current in accordance with applicable standards and regulations. At the same time, measures must be taken to stabilise the supply voltage. One such method is to control looms using a frequency converter. A frequency converter is used to start and control the loom; it is installed between the circuit breaker and the motor and controls the motor's rotational speed, thereby providing additional electrical energy savings [5]. Various starting methods are used to reduce the starting current in accordance with applicable standards and regulations [2]. At the same time, measures must be taken to stabilise the supply voltage. One such method is to control the speed of loom induction motors using a frequency converter [4].

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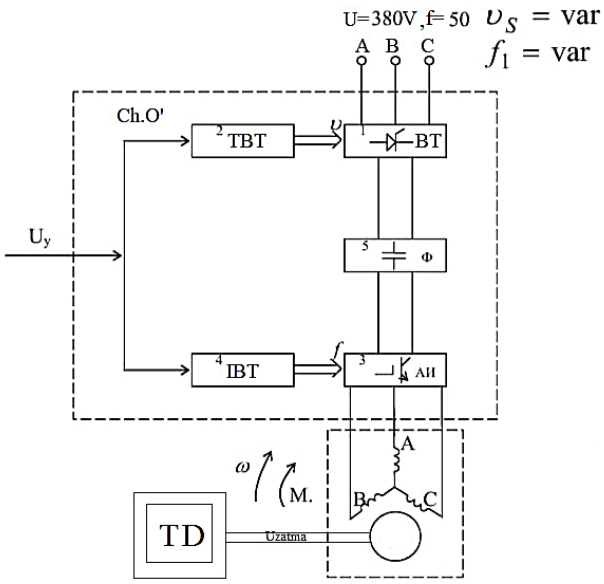

Figure 1. Closed-loop functional diagram for frequency control of induction motors in textile enterprise looms [5].

TBT, rectifier control system; IBT, inverter control system;
BT, controlled rectifier; ChO', frequency converter; TD, loom;
Uzatma, mechanical transmission; Ф, filter; АИ, autonomous inverter.

A circuit breaker is connected to the supply network at U = 380 V, and a frequency converter installed between the circuit breaker and the motor controls the rotational speed of the loom motor. During starting, the motor accelerates smoothly, preventing yarn breakage. In addition, electrical energy is saved during starting. Thus, this control method automatically regulates warp tension and weaving speed, ensuring an efficient weaving process and electrical energy savings [3].

The purpose is to start and control loom induction motors using a frequency converter installed between the circuit breaker and the induction motor. The converter controls the motor's rotational speed and provides additional electrical energy savings [6]. In addition to saving electrical energy during steady-state operation, induction motor drives with frequency-controlled speed can also use electrical energy efficiently during dynamic operation [1]. The dynamic operating modes of an induction motor drive include starting, speed regulation, braking and other modes [3]. When an induction motor is started directly from the mains without controlling the supply voltage, the starting current is 5–7 times the rated stator current, resulting in increased electrical energy losses in the stator winding. If the moments of inertia of the induction motor and the driven machinery are large, the transient process is prolonged [4]. Consequently, the stator winding insulation may heat up beyond its permissible temperature and fail. Therefore, when starting an induction motor with frequency-controlled speed, varying the frequency according to a specified law prevents excessive stator current and allows the motor to start

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under normal thermal conditions [4]. It is known that direct-on-line starting of induction motors produces large electromagnetic torques and currents. Large-amplitude oscillations of electromagnetic torque can cause dangerous dynamic loads in the stator winding and mechanical stresses in the kinematic chain of the electric drive [5]. Ensuring smooth starting and stopping, and thus preventing large dynamic stresses, extends the service life of the induction motor. In addition, smooth starting and stopping of high-power induction motors eliminate the effect of high-amplitude electrical loads on the supply network, which in turn benefits other consumers connected to the network [6]. As an example, a phase-voltage oscillogram was recorded under no-load conditions during direct-on-line starting of an induction motor used in looms and spinning machines at a textile enterprise (Figure 2). The oscillogram of the induction motor operating under no-load conditions is shown below. It can be seen that the phase voltage varies sinusoidally in this operating mode.

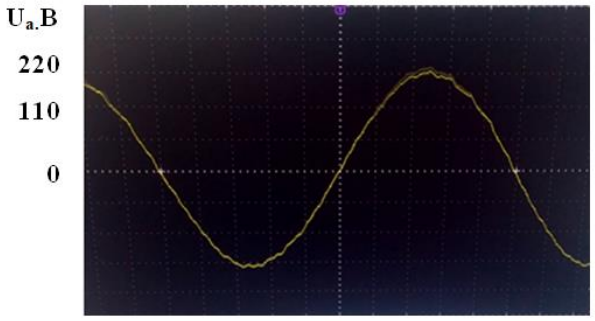

Figure 2. Phase-voltage oscillogram of an induction motor operating under no-load conditions. Phase voltage U_a is expressed in volts (V).

The next graph shows an oscillogram recorded during experimental studies of induction motors with the same voltage and power ratings, but operating under load. It can be seen that the phase-voltage waveform is distorted relative to a sinusoid because higher-order harmonics appear (Figure 3).

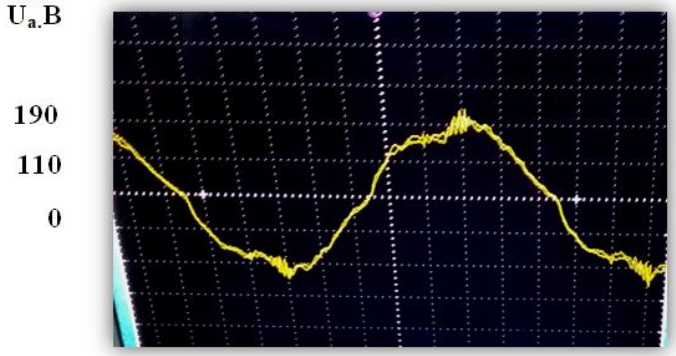

Figure 3. Phase-voltage oscillogram during starting of an induction motor with the loom connected. Phase voltage U_a is expressed in volts (V).

The next oscillogram (Figure 4) shows the phase voltage of the loom induction motor, with the same voltage and power ratings, operating under load with a frequency converter connected.

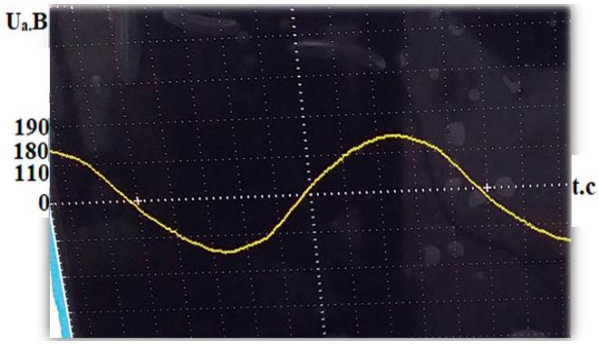

Figure 4. Phase-voltage oscillogram of an induction motor operating under load with a frequency converter connected. Phase voltage U_a is expressed in volts (V), and time t in seconds (s).

It can be seen from the graph that the higher-order harmonics have disappeared and that the phase-voltage waveform is close to sinusoidal. This indicates a reduction in energy consumption.

In conclusion, optimal control of the dynamic operating modes of induction motors used at textile enterprises, namely starting, speed regulation and braking, has been achieved. Frequency control has made it possible to save electrical energy, regulate induction motor speed, improve electric drive efficiency through smooth starting and stopping, and reduce induction motor power losses [5].

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5. 📊 ECONOMICS AND MANAGEMENT: INTERNATIONAL INTEGRATION, INNOVATIVE ENTREPRENEURSHIP AND SUSTAINABLE GROWTH.

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MARKAZIY OSIYO MAMLAKATLARIDA AHOLI TURMUSH DARAJASINING QIYOSIY TAHLILI

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Annotatsiya. *Maqolada Markaziy Osiyoning besh davlati — O‘zbekiston, Qozog‘iston, Qirg‘iziston, Tojikiston va Turkmanistonda aholi turmush darajasining asosiy xususiyatlari hamda o‘zgarish tendensiyalari tahlil qilinadi. Aholi jon boshiga yalpi ichki mahsulot, iqtisodiy o‘sish, umr ko‘rish davomiyligi, bandlik, daromadlar, kambag‘allik, ta’lim va sog‘liqni saqlash xizmatlaridan foydalanish imkoniyatlari qiyoslanadi. Iqtisodiy tuzilma, mehnat migratsiyasi, hududiy tafovutlar va davlat ijtimoiy siyosatining farovonlikka ta’siri yoritiladi. Raqamlashtirish, sun’iy intellekt, inson kapitalini rivojlantirish va mintaqaviy hamkorlik sharoitida turmush darajasini oshirishning ustuvor yo‘nalishlari taklif etiladi.*

Kalit so‘zlar: *Markaziy Osiyo, turmush darajasi, hayot sifati, aholi daromadlari, kambag‘allik, bandlik, ijtimoiy siyosat, inson kapitali, iqtisodiy rivojlanish, mintaqaviy integratsiya.*

Abstract. *The article examines the main features and trends in living standards in the five Central Asian countries: Uzbekistan, Kazakhstan, Kyrgyzstan, Tajikistan and Turkmenistan. It compares GDP per capita, economic growth, life expectancy, employment, household incomes, poverty, education and access to healthcare. The study highlights the influence of economic structure, labour migration, regional disparities and social policy on well-being. It identifies priorities for improving living standards through digitalisation, artificial intelligence, human capital development and regional cooperation.*

Keywords: *Central Asia, living standards, quality of life, household income, poverty, employment, social policy, human capital, economic development, regional integration.*

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KIRISH

Aholi turmush darajasi davlatning ijtimoiy-iqtisodiy rivojlanishini ifodalovchi muhim mezonlardan biridir. U faqat moddiy farovonlikni emas, balki aholining asosiy ehtiyojlari qondirilishi, ta’lim va tibbiy xizmatlardan foydalanishi, uy-joy sharoiti, munosib ish bilan ta’minlanishi, ijtimoiy himoya hamda shaxsiy rivojlanish imkoniyatlarini ham aks ettiradi.

Markaziy Osiyo mamlakatlari umumiy tarixiy meros, geografik yaqinlik va madaniy aloqalarga ega bo‘lsa-da, iqtisodiyot tarkibi, tabiiy resurslar, sanoatlashuv darajasi, demografik jarayonlar va islohotlar sur’ati jihatidan farqlanadi. So‘nggi yillarda mintaqa davlatlari iqtisodiyotni modernizatsiya qilish, tadbirkorlikni qo‘llab-quvvatlash, investitsiyalarni jalb etish va aholi farovonligini oshirishga intilmoqda. Biroq iqtisodiy o‘sish uning natijalari barcha ijtimoiy guruhlarga teng taqsimlanishini o‘z-o‘zidan kafolatlamaydi.

Maqolaning maqsadi — Markaziy Osiyo mamlakatlarida turmush darajasini tavsiflovchi asosiy ko‘rsatkichlarni qiyoslash, umumiy muammolarni aniqlash va barqaror farovonlikni ta’minlash bo‘yicha ustuvor yo‘nalishlarni asoslash. Tahlilda Jahon banki, BMT tizimi va milliy statistika organlari ma’lumotlari asos qilib olinadi.

1. Turmush darajasini baholashning nazariy asoslari

Iqtisodiy adabiyotlarda turmush darajasi aholining moddiy va ma’naviy ne’matlar bilan ta’minlanganligi hamda kundalik hayot sharoitlarini ifodalaydi. Turmush darajasi, odatda, daromad, iste’mol, uy-joy va xizmatlardan foydalanish kabi miqdoriy ko‘rsatkichlar orqali baholanadi. Hayot sifati esa kengroq tushuncha bo‘lib, sog‘liq, ta’lim, xavfsizlik, ekologik muhit, ijtimoiy farovonlik va o‘z salohiyatini ro‘yobga chiqarish imkoniyatlarini ham qamrab oladi.

Kompleks baholash uchun aholi jon boshiga daromad, ish haqi va pensiya miqdori, bandlik va ishsizlik, kambag‘allik darajasi, iste’mol xarajatlari, uy-joy hamda kommunal xizmatlar sifati, umr ko‘rish davomiyligi, ta’lim va tibbiyotdan foydalanish, inson taraqqiyoti indeksi va daromadlar tengsizligi kabi ko‘rsatkichlardan foydalanish zarur.

Yalpi ichki mahsulotning aholi jon boshiga to‘g‘ri keladigan miqdori iqtisodiy ishlab chiqarish hajmini ko‘rsatadi, biroq u farovonlikning to‘liq o‘lchovi emas. Ushbu ko‘rsatkich daromadlarning taqsimlanishi, narxlar darajasi, xarid qobiliyati, hududiy tafovutlar va davlat xizmatlarining mavjudligini bevosita aks ettirmaydi. Shu sababli nominal ko‘rsatkichlar bilan bir qatorda xarid qobiliyati pariteti va ijtimoiy indikatorlarni ham hisobga olish lozim.

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2. Markaziy Osiyo mamlakatlarining iqtisodiy xususiyatlari

Qozog‘iston mintaqadagi eng yirik iqtisodiyotga ega. Uning iqtisodiy bazasini neft-gaz sanoati, konchilik, metallurgiya, qishloq xo‘jaligi, transport va moliyaviy xizmatlar tashkil etadi. Energiya resurslari eksportidan olinadigan daromadlar ijtimoiy sohani moliyalashtirish imkoniyatlarini kengaytiradi.

O‘zbekiston mintaqadagi eng ko‘p aholiga ega bo‘lib, nisbatan diversifikatsiyalashgan iqtisodiy tuzilma bilan ajralib turadi. Sanoat, qishloq xo‘jaligi, qurilish, savdo, xizmatlar va kichik biznes muhim o‘rin tutadi. Islohotlar xususiy sektorni kengaytirish, raqobatbardoshlikni oshirish va yangi ish o‘rinlari yaratishga qaratilgan.

Qirg‘iziston iqtisodiyotida qishloq xo‘jaligi, savdo, xizmatlar, konchilik va mehnat migrantlari pul o‘tkazmalari muhim ahamiyatga ega. Turizm va gidroenergetika iqtisodiy o‘sishning istiqbolli manbalari hisoblanadi. Tojikistonda gidroenergetika, qishloq xo‘jaligi va qazib olish sanoati salohiyati mavjud, biroq ishlab chiqarish bazasining cheklanganligi, geografik omillar va xorijdagi migrantlar yuboradigan mablag‘larga bog‘liqlik sezilarli ta’sir ko‘rsatadi.

Turkmaniston yirik tabiiy gaz va neft zaxiralariga ega. Energetika eksport tushumlarining asosiy manbalaridan biri bo‘lib, qishloq xo‘jaligi, sanoat, transport infratuzilmasi va ichki bozorni rivojlantirish ham muhim vazifalardir. Demak, resurslar bilan ta’minlanganlik va iqtisodiyotning tarmoq tarkibi davlatlarning aholi turmush darajasini oshirish imkoniyatlariga bevosita ta’sir ko‘rsatadi.

3. Asosiy iqtisodiy va ijtimoiy ko‘rsatkichlarning qiyosiy tahlili

Jahon banki ma’lumotlariga ko‘ra, 2024-yilda Markaziy Osiyo mamlakatlarida aholi jon boshiga YaIM va real iqtisodiy o‘sish sur’atlari sezilarli farq qilgan. Quyidagi jadvalda maqola uchun foydalanilgan ma’lumotlar keltirilgan.

1-jadval. Markaziy Osiyo mamlakatlarining asosiy makroiqtisodiy ko‘rsatkichlari, 2024-yil

Mamlakat	**Aholi jon boshiga YaIM, AQSh dollari**	**YaIM o‘sishi, %**
Qozog‘iston	14 154,6	5,0
Turkmaniston	6 856,7	6,3
O‘zbekiston	3 161,7	6,5
Qirg‘iziston	2 420,2	9,0
Tojikiston	1 341,2	8,4

Manba: Jahon bankining 2024-yil ma’lumotlari asosida.

Jadvaldan ko‘rinadiki, aholi jon boshiga YaIM bo‘yicha Qozog‘iston yetakchi o‘rinda. Bunga iqtisodiyot ko‘lami, qazib olish sanoati, uglevodorodlar eksporti va ayrim tarmoqlardagi mehnat unumdorligi ta’sir ko‘rsatadi. Turkmanistonning

ko‘rsatkichi energetika sektorining salmog‘i bilan izohlanadi. O‘zbekiston iqtisodiy o‘sish sur’atini saqlab, sanoat, tadbirkorlik va xizmatlar sohasini kengaytirish imkoniyatiga ega. Qirg‘iziston va Tojikistonda aholi jon boshiga YaIM pastroq bo‘lsa-da, yuqori o‘sish sur’atlari iqtisodiy salohiyat mavjudligini ko‘rsatadi.

Keltirilgan YaIM ko‘rsatkichlari joriy AQSh dollarida hisoblangan va mamlakatlar o‘rtasidagi narxlar farqini hisobga olmaydi. Shu bois real turmush darajasini baholashda xarid qobiliyati pariteti, uy xo‘jaliklarining real daromadlari va iste’mol imkoniyatlari bilan to‘ldirilishi kerak.

4. Aholi daromadlari, bandlik va kambag‘allik

Aholi farovonligining moddiy asosini ish haqi, tadbirkorlik daromadlari, pensiya va nafaqalar, ijtimoiy transfertlar hamda xorijdan yuboriladigan pul o‘tkazmalari tashkil etadi. Daromadlar tarkibi mamlakatlar bo‘yicha farqlanadi: Qozog‘istonda sanoat, neft-gaz, qurilish, moliya va davlat boshqaruvidagi ish haqi muhim; O‘zbekistonda sanoat va xizmatlar, tadbirkorlik, qishloq xo‘jaligi hamda migrantlar pul o‘tkazmalari muhim manbalardir.

Qirg‘iziston va Tojikistonda mehnat migrantlarining pul o‘tkazmalari uy xo‘jaliklari daromadida katta ulushga ega. Jahon banki ma’lumotlariga ko‘ra, 2024-yilda shaxsiy pul o‘tkazmalari Tojikiston YaIMining taxminan 47,9 foizini, Qirg‘iziston YaIMining 26,6 foizini va O‘zbekiston YaIMining 14,4 foizini tashkil etgan; Qozog‘istonda bu ko‘rsatkich taxminan 0,1 foiz bo‘lgan. Bu raqamlar ayrim mamlakatlarda oilalar farovonligi tashqi mehnat bozorlariga qanchalik bog‘liqligini ko‘rsatadi.

Mehnat migratsiyasi ikki tomonlama ta’sirga ega. Bir tomondan, pul o‘tkazmalari oilalarga uy-joy sotib olish, farzandlar ta’limi va kundalik ehtiyojlarni moliyalashtirishga yordam beradi. Boshqa tomondan, tashqi iqtisodiy inqirozlar, migratsiya siyosatidagi o‘zgarishlar va valyuta kurslarining tebranishi uy xo‘jaliklari daromadlarini beqarorlashtirishi mumkin. Shu sababli mintaqa davlatlari ichki mehnat bozorida unumdor va barqaror ish o‘rinlarini yaratishi zarur.

Qayta ishlash sanoati, kichik biznes, turizm, axborot texnologiyalari va zamonaviy agrokooperatsiyani rivojlantirish bandlikni kengaytirish hamda majburiy migratsiyani kamaytirishga xizmat qiladi. Kambag‘allikka qarshi siyosat esa milliy metodikalar va yashash qiymatidagi farqlarni hisobga olishi, manzilli yordamni kasbiy tayyorlash va ishga joylashtirish dasturlari bilan uyg‘unlashtirishi lozim.

5. Demografik va ijtimoiy ko‘rsatkichlar

Turmush darajasi umr ko‘rish davomiyligi, ta’lim va sog‘liqni saqlash xizmatlarining sifati bilan chambarchas bog‘liq. Jahon bankining World Development Indicators ma’lumotlarida 2024-yil uchun tug‘ilishda kutilayotgan

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umr davomiyligi Qozog‘istonda 75 yil, O‘zbekistonda 73 yil, Qirg‘iziston va Tojikistonda 72 yil, Turkmanistonda 70 yil sifatida keltirilgan.

2-jadval. Markaziy Osiyo mamlakatlarida kutilayotgan umr davomiyligi, 2024-yil

Mamlakat	**Umr davomiyligi, yil**
Qozog‘iston	75
O‘zbekiston	73
Qirg‘iziston	72
Tojikiston	72
Turkmaniston	70

Manba: Jahon banki, World Development Indicators.

Umr davomiyligidagi tafovutlar tibbiy xizmat sifati, daromad, mehnat va yashash sharoitlari, ovqatlanish, ekologik vaziyat, kasalliklarning oldini olish va tibbiy infratuzilmaning qulayligi bilan bog‘liq. Ayniqsa, tog‘li va olis hududlarda birlamchi tibbiy yordamdan foydalanish imkoniyatini kengaytirish muhim.

Ta’lim inson kapitalining asosiy omili hisoblanadi. Xodimlarning malakasi ularning mehnat bozoridagi raqobatbardoshligi, unumdorligi va munosib daromad olish imkoniyatini belgilaydi. Shu sababli kasbiy va oliy ta’limni rivojlantirish, universitetlar bilan korxonalar hamkorligini kuchaytirish, raqamli ta’lim texnologiyalarini joriy etish hamda muhandislik, iqtisodiyot, moliya, IT va sun’iy intellekt bo‘yicha mutaxassislar tayyorlash zarur.

6. Hududiy tafovutlar va ijtimoiy tengsizlik

Mamlakat ichida ham turmush darajasi yashash joyi, kasb, yosh, ma’lumot va mulkiy holatga qarab farqlanadi. Qozog‘istonda yirik shaharlar, sanoat markazlari va qishloqlar o‘rtasida; O‘zbekistonda poytaxt, viloyat markazlari va chekka qishloq hududlari o‘rtasida imkoniyatlar tafovuti mavjud. Qirg‘iziston va Tojikistonda tog‘li relyef, aholi punktlarining uzoqligi va transport infratuzilmasi cheklanganligi xizmatlardan foydalanishga ta’sir qiladi. Turkmanistonda ham hududiy infratuzilma va ijtimoiy xizmatlar sifatini oshirish muhim vazifadir.

Shu bois farovonlik siyosati faqat o‘rtacha daromadlarni oshirish bilan cheklanmasligi, hududiy va ijtimoiy tafovutlarni qisqartirishga ham qaratilishi kerak. Yoshlar, ayollar, qishloq aholisi, nogironligi bo‘lgan shaxslar va ijtimoiy jihatdan zaif guruhlar uchun teng imkoniyatlar yaratish alohida ahamiyatga ega.

7. Davlat ijtimoiy siyosatining ustuvor yo‘nalishlari

Davlat ijtimoiy siyosati munosib yashash sharoitlarini ta’minlash, kambag‘allikni kamaytirish, bandlikni qo‘llab-quvvatlash va inson kapitalini rivojlantirishga xizmat qiladi. Markaziy Osiyo mamlakatlari uchun bir necha ustuvor yo‘nalishlarni ajratish mumkin.

Birinchidan, mehnat unumdorligini oshirish, ish haqi o‘sishi, tadbirkorlik va o‘zini o‘zi band qilish imkoniyatlarini kengaytirish orqali aholi daromadlarini ko‘paytirish zarur. Ikkinchidan, ijtimoiy yordamni ehtiyojmand oilalarga manzilli yo‘naltirish, uni kasbiy o‘qitish va ishga joylashtirish bilan bog‘lash lozim. Uchinchidan, sifatli tibbiyot va ta’lim xizmatlariga investitsiyalarni ko‘paytirish uzoq muddatli rivojlanishning poydevoridir.

To‘rtinchidan, uy-joyning qulayligini oshirish, ipoteka mexanizmlarini takomillashtirish, muhandislik tarmoqlari va kommunal xizmatlar sifatini yaxshilash muhim. Beshinchidan, qishloq hududlarida yo‘llar, ichimlik suvi, gaz va elektr ta’minoti, internet hamda yangi ish o‘rinlarini rivojlantirish talab etiladi. Oltinchidan, ijtimoiy himoya tizimi faqat past daromadni qoplashga emas, fuqarolarning mustaqil ravishda farovonligini oshirish imkoniyatlarini shakllantirishga yo‘naltirilishi kerak.

8. Raqamlashtirish va sun’iy intellektning turmush darajasiga ta’siri

Raqamli transformatsiya Markaziy Osiyo mamlakatlarining ijtimoiy-iqtisodiy rivojlanishida tobora muhim omilga aylanmoqda. Raqamli texnologiyalar va sun’iy intellekt mehnat unumdorligini oshirish, yangi ish o‘rinlarini yaratish, davlat xizmatlari sifatini yaxshilash, ta’lim va tibbiyotdan foydalanish imkoniyatlarini kengaytirishi mumkin.

Birinchi yo‘nalish — mehnat bozorini raqamlashtirish. Elektron bandlik platformalari, masofaviy ish va raqamli tadbirkorlik, ayniqsa, yoshlar hamda olis hududlar aholisi uchun qo‘shimcha imkoniyatlar yaratadi. Ikkinchi yo‘nalish — ta’limda sun’iy intellektdan foydalanish: moslashtirilgan o‘quv platformalari ta’limni individual ehtiyojlarga moslashtirishi, kasbiy tayyorgarlik sifatini oshirishi mumkin.

Uchinchi yo‘nalish — raqamli sog‘liqni saqlash. Telemeditsina, elektron tibbiy kartalar va intellektual diagnostika tizimlari qishloq hamda borish qiyin bo‘lgan hududlarda xizmatlar qamrovini yaxshilaydi. To‘rtinchi yo‘nalish — elektron savdo, moliyaviy texnologiyalar, raqamli xizmatlar va platforma iqtisodiyoti orqali tadbirkorlik hamda daromad manbalarini kengaytirish. Beshinchi yo‘nalish — katta ma’lumotlar va sun’iy intellekt yordamida davlat boshqaruvi va ijtimoiy yordamning manzilliligini kuchaytirish.

Biroq raqamli o‘zgarishlar raqamli savodxonlikni oshirish, axborot xavfsizligini ta’minlash va texnologiyalardan foydalanishda teng imkoniyat yaratish bilan birga olib borilishi lozim. Aks holda, raqamli tafovut mavjud ijtimoiy tengsizlikni yanada kuchaytirishi mumkin.

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9. Mintaqaviy hamkorlik va farovonlik istiqbollari

Markaziy Osiyo mamlakatlari umumiy ijtimoiy-iqtisodiy muammolarni hamkorlikda hal etish uchun katta salohiyatga ega. O‘zaro savdo va sanoat kooperatsiyasini rivojlantirish, qishloq xo‘jaligi va sanoatda qo‘shma korxonalar tashkil etish, transport-logistika yo‘laklarini kengaytirish investitsiyalar va bandlikni oshirishga xizmat qiladi.

Hamkorlikning muhim yo‘nalishlari qatoriga suv va energetika resurslaridan oqilona foydalanish, ta’lim va ilmiy almashinuv, mintaqaviy raqamli platformalar, malakali kadrlar tayyorlash va transchegaraviy turizmni rivojlantirish kiradi. Buyuk ipak yo‘li merosi, Samarqand, Buxoro, Xiva, Turkiston va O‘sh kabi tarixiy shaharlar, shuningdek, tog‘li va tabiiy hududlar qo‘shma turistik yo‘nalishlarni shakllantirish uchun imkoniyat yaratadi.

Mintaqaviy turizm kichik biznes, mehmonxona xo‘jaligi, umumiy ovqatlanish, transport va hunarmandchilikdan olinadigan daromadlarni ko‘paytirishi mumkin. Buning uchun davlatlar iqtisodiy manfaatlarini muvofiqlashtirishi, chegaraoldi infratuzilmasini yaxshilashi va qo‘shma loyihalarni amalga oshirish mexanizmlarini shakllantirishi zarur.

10. Muammolar va turmush darajasini oshirish bo‘yicha takliflar

Tahlil Markaziy Osiyo mamlakatlari uchun bir qator umumiy muammolar mavjudligini ko‘rsatadi: mamlakatlar o‘rtasida daromad va iqtisodiy imkoniyatlar tafovuti; yuqori unumdor ish o‘rinlarining yetishmasligi; ayrim davlatlarda mehnat migratsiyasi va pul o‘tkazmalariga kuchli bog‘liqlik; shahar va qishloq hududlari rivojlanishining notekisligi; iqtisodiyotni yetarli darajada diversifikatsiya qilmaslik; sifatli ta’lim va tibbiyot xizmatlaridan foydalanishdagi farqlar; kadrlar malakasini oshirish zarurati; suv tanqisligi va iqlim o‘zgarishi bilan bog‘liq ekologik muammolar.

Ushbu muammolarni yumshatish uchun quyidagi chora-tadbirlar maqsadga muvofiq: yuqori texnologiyali ishlab chiqarish va qayta ishlash sanoatini rivojlantirish; kichik va o‘rta biznesni qo‘llab-quvvatlash; inson kapitaliga investitsiyalarni ko‘paytirish; yoshlar uchun zamonaviy ish o‘rinlari yaratish; ayollarning iqtisodiy faolligini oshirish; agrosanoat majmuasi va qishloq xo‘jaligi mahsulotlarini qayta ishlashni kengaytirish; pensiya va ijtimoiy himoya tizimlarini takomillashtirish; sifatli uy-joy va infratuzilmadan foydalanish imkoniyatini kengaytirish; raqamli texnologiyalar hamda sun’iy intellektni joriy etish; mintaqaviy iqtisodiy hamkorlikni mustahkamlash.

Bu chora-tadbirlarni amalga oshirishda har bir mamlakatning milliy xususiyatlari, resurslari va institutsional imkoniyatlarini hisobga olish, xorijiy tajribani esa mahalliy sharoitga moslashtirish lozim.

XULOSA

Qiyosiy tahlil Markaziy Osiyo mamlakatlarida aholi turmush darajasi iqtisodiyot ko‘lami va tarkibi, tabiiy resurslar, bandlik, daromadlar, ijtimoiy infratuzilma hamda davlat siyosati samaradorligiga bog‘liq holda sezilarli farqlanishini ko‘rsatdi. Qozog‘iston aholi jon boshiga YaIM va kutilayotgan umr davomiyligi bo‘yicha yuqori ko‘rsatkichlarga ega. Turkmanistonning iqtisodiy salohiyati energetika resurslari bilan bog‘liq. O‘zbekiston iqtisodiy o‘sish, sanoat, tadbirkorlik va xizmatlarni rivojlantirish uchun muhim imkoniyatlarga ega. Qirg‘iziston va Tojikistonda esa gidroenergetika, qishloq xo‘jaligi, turizm va inson kapitali iqtisodiy rivojlanishning istiqbolli omillaridir.

Turmush darajasini faqat aholi jon boshiga YaIM orqali baholash yetarli emas. Real daromadlar va xarid qobiliyati, daromadlar taqsimoti, kambag‘allik, ta’lim va tibbiyot xizmatlarining sifati, uy-joy sharoiti hamda ijtimoiy himoya ko‘rsatkichlari ham e’tiborga olinishi kerak. Shu ma’noda, makroiqtisodiy o‘sish natijalarini aholining keng qatlamlari farovonligiga aylantiradigan inklyuziv rivojlanish modeli muhim ahamiyat kasb etadi.

Kelgusida inson kapitalini rivojlantirish, iqtisodiyotni diversifikatsiya qilish, unumdor ish o‘rinlari yaratish, raqamli transformatsiya va sun’iy intellektdan samarali foydalanish, shuningdek, mintaqaviy integratsiyani chuqurlashtirish turmush darajasini oshirishning asosiy omillari bo‘lib qoladi. Davlatlar muvaffaqiyati ishlab chiqarish hajmi va eksport tushumlari bilangina emas, balki ushbu yutuqlarning insonlar farovonligi, iqtisodiy imkoniyatlari va munosib hayot sharoitlariga qay darajada xizmat qilishi bilan baholanishi lozim.

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KIÇIK BIZNES SUBYEKTLARINING SAMARADORLIK KÖRSATKIÇLARINI OŞIRIŞ STRATEGIYASI

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Annotatsiya. *Mazkur tezisda kiçik biznes subyektlarining faoliyat samaradorligini baholaş va oşirişga qaratilgan strategik yondaşuv asoslanadi. Rentabellik, mehnat unumdorligi, xarajatlar siğimi, debitorlik qarzlarining aylaniş muddati va takroriy mijozlar uluşidan iborat körsatkiçlar tizimi taklif etiladi. Rasmiy statistika va xalqaro tadqiqotlar asosida raqamlaştiriş, xarajatlarni boşqariş, kadrlar salohiyatini oşiriş hamda mijozlarga yönaltirilgan boşqaruvning ustuvor yönalişlari aniqlanadi.*

Kalit sözlar: *kiçik biznes, samaradorlik, strategik boşqaruv, rentabellik, mehnat unumdorligi, KPI, raqamlaştiriş.*

Аннотация. *В тезисе обоснован стратегический подход к повышению эффективности субъектов малого бизнеса. Предложена система показателей, включающая рентабельность, производительность труда, долю затрат, период оборачиваемости дебиторской задолженности и долю повторных клиентов. Определены основные направления повышения результативности за счёт цифровизации, финансового контроля и развития управленческих компетенций.*

Ключевые слова: *малый бизнес, эффективность, стратегическое управление, рентабельность, цифровизация.*

Abstract. *This thesis proposes a strategic framework for improving the performance of small business entities. A set of indicators covering profitability, labor productivity, cost intensity, receivables collection period and repeat-customer share is presented. Drawing on official statistics and international research, the paper highlights digital adoption, cost control, workforce capabilities and customer-focused management as key priorities.*

Keywords: *small business, efficiency, strategic management, profitability, digitalization, KPIs.*

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KIRIŞ

Kiçik biznes subyektlari yangi iş örinlarini yaratiş, raqobat muhitini şakllantiriş va mahalliy bozorlarni mahsulot hamda xizmatlar bilan ta'minlaşda muhim örin tutadi. Biroq korxonalar sonining ortişi har doim ham ularning resurslardan foydalaniş samaradorligi yaxşilanganini anglatmaydi. Şu bois kiçik tadbirkorlikni rivojlantirişda miqdoriy kengayiş bilan bir qatorda rentabellik, unumdorlik, tölov qobiliyati va bozor barqarorligini baholaş dolzarbdir.

Özbekiston Respublikasi Milliy statistika qömitasining SIAT ma'lumotlariga köra, kiçik biznes va xususiy tadbirkorlikning yalpi içki mahsulotdagi uluşi 2023-yilda 53,8%, 2024-yilda 53,5%, 2025-yilda 52,2% ni taşkil etgan. Namangan viloyatida tegişli körsatkiçlar 74,0%, 73,9% va 73,6% bölgan [1]. Uşbu uluşning özgarişi faqat kiçik korxonalar unumdorligidagi özgariş bilan izohlanmaydi: yirik korxonalar dinamikasi hamda iqtisodiyotning tarmoq tarkibi ham uluşga ta'sir körsatadi. Şuning uçun korxona darajasidagi alohida KPIlar zarur.

Özbekiston Respublikasi Prezidentining 2025-yil 19-martdagi PF–50-son Farmonida kiçik va örta biznesning iqtisodiyotdagi örnini oşiriş, uning raqobatbardoşligi va bozorga çiqiş imkoniyatlarini kengaytiriş vazifalari belgilangan [2]. Tezisning maqsadi — kiçik biznes subyektlari samaradorligini oşiriş uçun ölçanadigan maqsadlar va ularni amalga oşiriş bosqiçlarini birlaştiruvçi strategik modelni taklif etiş.

TADQIQOT METODOLOGIYASI

Tadqiqotda rasmiy statistik ma'lumotlarni qiyosiy tahlil qiliş, ilmiy manbalarni umumlaştiriş, tizimli yondaşuv va KPI asosida baholaş usullaridan foydalanildi. Korxona içidagi boşqaruv qarorlari bilan natijaviy körsatkiçlar örtasidagi mantiqiy boğliqlik tahlil qilindi. Taklif etilgan model metodik tavsiya bölib, alohida korxonalar böyiça ötkazilgan tajriba yoki ekonometrik baholaş natijasi sifatida talqin qilinmaydi.

NATIJALAR VA MUHOKAMA

Samaradorlikni daromad hajmi yoki foyda summasi bilan çeklab bölmaydi. Tuşum oşgan şaroitda xarajatlar undan tezroq köpayişi, mijozlarga sotilgan mahsulot uçun tölovlarning keçikişi yoki işlab çiqariş quvvatlaridan past darajada foydalaniş korxonaning real holatini yomonlaştirişi mumkin. Şu sababli moliyaviy, operatsion va bozor körsatkiçlarini birgalikda monitoring qiliş taklif etiladi.

1-jadval. Kiçik biznes subyektlarida tavsiya etiladigan samaradorlik KPIlari

Körsatkiç	Hisoblaş tartibi	Strategik talqin
Sof foyda rentabelligi, %	Sof foyda / sof tuşum × 100	Foydalilik darajasi; oşişi maqsadga muvofiq

Körsatkiç	Hisoblaş tartibi	Strategik talqin
Mehnat unumdorligi	Taqqoslanadigan narxlardagi tuşum / örtaça xodimlar soni	Bir xodimga töğri keladigan natija
Xarajatlar siğimi, %	Asosiy faoliyat xarajatlari / sof tuşum × 100	Bir birlik tuşumga sarflangan xarajat; kamayişi ijobiy
Debitorlik qarzi muddati, kun	Örtaça savdo debitorligi / kreditga sotuv × davr kunlari	Tölovlarni yiğiş tezligi; kamayişi ijobiy
Takroriy mijozlar uluşi, %	Qayta xarid qilgan mijozlar / jami mijozlar × 100	Mijozlar sodiqligi va talab barqarorligi

Izoh: körsatkiçlar bir xil hisob davri, faoliyat sohasi va korxona hajmiga mos holda hisoblanişi lozim. Mehnat unumdorligini real dinamikada baholaş uçun narxlar ta'sirini bartaraf etiş muhim; kreditga sotuv ajratib körsatilmagan taqdirda debitorlik aylanişi muqobil körsatkiç bilan almaştiriladi.

KPIlar uçun bazaviy qiymat, çoraklik maqsad va mas'ul şaxs belgilanadi. Har bir körsatkiç maqsadga yaqinlaşiş darajasi böyiça 0 dan 100 gaça normallaştirilib, korxona ustuvorliklariga muvofiq vazn berilişi mumkin. Masalan, rentabellik — 30%, unumdorlik — 25%, xarajatlar siğimi — 20%, debitorlik muddati — 15%, takroriy mijozlar uluşi — 10%. Mazkur vaznlar universal me'yor emas, balki sinovdan ötkazilişi lozim bölgan namunaviy boşqaruv yeçimidir.

Strategiyani amalga oşiriş uçun beş yönaliş bir-biri bilan uyğunlaştiriladi. Birinçidan, mahsulot va mijozlar kesimida marjinal foyda hisoblanib, past foydali operatsiyalarga xarajatlarni qisqartiriş orqali moliyaviy intizom mustahkamlanadi. Ikkinçidan, sotuv, ombor va buxgalteriya ma'lumotlari yagona hisob tizimiga birlaştirilib, takrorlanuvçi jarayonlar raqamlaştiriladi. Uçinçidan, mijozlarni segmentlaş, qayta xaridlarni rağbatlantiriş va sotuvdan keyingi aloqa mexanizmlari joriy qilinadi. Törtinçidan, xodimlarning malakasi hamda natijaga yönaltirilgan rağbatlantiriş tizimi takomillaştiriladi. Beşinçidan, pul oqimi prognozi, ehtiyot likvidlik zaxirasi va ta'minotçilarni diversifikatsiya qiliş orqali moliyaviy tavakkalçilik boşqariladi.

Mazkur yondaşuv xalqaro tajribaga mos keladi. OECDning 2025-yilgi D4SME tadqiqotida raqamlaştiriş kiçik biznesning bozorga çiqişi va operatsion samaradorligini oşirişi, biroq xarajatlar va xodimlarni öqitiş bilan boğliq çeklovlar mavjudligi qayd etilgan [3]. Jahon bankining Özbekiston böyiça ma'lumotlari kiçik va örta korxonalar uçun moliyalaştiriş imkoniyatlarini kengaytiriş dolzarb ekanini körsatadi [4]. Şu sababli raqamli vosita sotib olişning özi strategiya natijasi böla olmaydi: uning KPIga ta'siri ölçanişi kerak.

2-jadval. Strategiyani bosqiçma-bosqiç joriy etiş rejasi

Bosqiç	Asosiy harakatlar	Nazorat natijasi
1–30 kun	Sönggi 12 oylik ma'lumotlar auditi, bazaviy KPIlarni hisoblaş, muammoli mahsulot va jarayonlarni ajratiş	Boşlanğiç körsatkiçlar paneli va ustuvorliklar röyxati
31–90 kun	Hisob va sotuv jarayonlarini raqamlaştiriş, xarajatlar limitini belgilaş, debitorlik nazoratini kuçaytiriş	Oylik KPI monitoringi va mas'ullar kesimidagi hisobot
91–180 kun	Jarayonlarni optimallaştiriş, xodimlarni öqitiş, mijozlar bilan işlaş usullarini qayta köriş	Bazaviy davrga nisbatan tekşirilgan KPI özgarişi

Strategiyaning kutiladigan samarasi oldindan belgilangan foizlarda emas, balki bazaviy davr bilan taqqoslanadigan hisob ma'lumotlari asosida baholanişi kerak. Jumladan, bir vaqtning özida rentabellikning ösişi, xarajatlar siğimining pasayişi va pul tuşumlarining barqarorlaşuvi kuzatilsa, boşqaruv sifatidagi ijobiy siljiş haqida asosli xulosa qiliş mumkin. Aks holda, faqat tuşumning ösişi samaradorlik oşganini isbotlamaydi.

XULOSA

Kiçik biznes subyektlarining samaradorlik körsatkiçlarini oşiriş strategiyasi ölçab böladigan maqsadlar, raqamli axborot ta'minoti va muntazam boşqaruv nazoratiga tayanişi lozim. Taklif etilgan beş körsatkiçli KPI tizimi korxona rahbariga foydalilik, unumdorlik, xarajatlar, tölov intizomi va mijozlar barqarorligini birgalikda kuzatiş imkonini beradi. Amaliyotga joriy etişda korxonaning tarmoği, miqyosi va moliyaviy holatidan kelib çiqib indikatorlar hamda maqsad qiymatlari moslaştiriladi. Modelning amaliy natijadorligini tekşiriş uçun keyingi tadqiqotlarda korxonalar kesimida boşlanğiç va yakuniy KPIlarni qiyoslaş maqsadga muvofiq.

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KIÇIK BIZNES KORXONALARINI BOŞQARIŞ SAMARADORLIGINI OŞIRIŞ

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Annotatsiya. *Maqolada Özbekiston şaroitida kiçik biznes korxonalarini boşqariş samaradorligini oşirişning taşkiliy-iqtisodiy yönalişlari örganilgan. Tadqiqotning maqsadi moliyaviy natijalar, mijozlar bilan munosabatlar, içki biznes jarayonlari va inson kapitalini yagona baholaş tizimida uyğunlaştiruvçi amaliy boşqaruv modelini işlab çiqişdan iborat. Rasmiy statistika, normativ-huquqiy hujjatlar va xalqaro ilmiy manbalar asosida tavsifiy, qiyosiy va tizimli tahlil usullari qöllanildi. 2023–2025-yillardagi iqtisodiy körsatkiçlar hamda Namangan viloyati ma’lumotlari tahlil qilindi. Natijada kiçik korxonalar uçun tört yönalişli körsatkiçlar tizimi, ma’lumotlarga asoslangan qaror qabul qiliş tartibi va bosqiçma-bosqiç joriy etiş mexanizmi taklif etildi. Taklif etilgan model korxona darajasidagi empirik sinovdan ötkazilmagan bölib, uning ta’sirini aniqlaş uçun keyingi tadqiqotlarda amaliy baholaş talab etiladi.*

Kalit sözlar: *kiçik biznes, boşqaruv samaradorligi, strategik rejalaştiriş, raqamlaştiriş, KPI, moliyaviy barqarorlik, inson kapitali, Namangan viloyati.*

Аннотация. *В статье рассматриваются организационно-экономические направления повышения эффективности управления малыми предприятиями в Узбекистане. Цель исследования — разработать прикладную модель управления, объединяющую финансовые результаты, взаимоотношения с клиентами, внутренние процессы и человеческий капитал в единую систему оценки. Использованы описательный, сравнительный и системный методы анализа официальной статистики, нормативных документов и международных исследований. Проанализированы данные за 2023–2025 годы, в том числе по Наманганской области. Предложены система показателей по четырём направлениям, механизм принятия решений на основе данных и последовательность внедрения. Модель носит рекомендательный характер и требует дальнейшей эмпирической проверки на уровне предприятий.*

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Ключевые слова: *малый бизнес, эффективность управления, стратегическое планирование, цифровизация, ключевые показатели эффективности, финансовая устойчивость, человеческий капитал.*

Abstract*. This article examines organisational and economic mechanisms for improving management effectiveness in small enterprises in Uzbekistan. The study aims to propose an applied management model integrating financial performance, customer relations, internal processes and human capital into a unified evaluation framework. Descriptive, comparative and systems-based analysis is applied to official statistics, legal documents and international literature. Trends for 2023–2025, including evidence from Namangan region, are reviewed. The paper proposes a four-dimensional performance indicator system, a data-informed decision-making process and a phased implementation mechanism. As the framework has not yet been tested using enterprise-level observations, its effectiveness remains a proposition for subsequent empirical research rather than a demonstrated causal result.*

Keywords: *small business, management effectiveness, strategic planning, digitalisation, key performance indicators, financial resilience, human capital.*

KIRIŞ

Kiçik biznes mamlakat iqtisodiyotida işlab çiqariş va xizmatlar hajmini kengaytiriş, bandlikni qöllab-quvvatlaş, mahalliy bozorlarni tovar va xizmatlar bilan ta’minlaş hamda raqobat muhitini şakllantirişda muhim örin tutadi. Biroq korxonalar sonining ortişi yoki ularning yalpi içki mahsulotdagi uluşi yuqoriligi alohida korxonaning samarali boşqarilayotganini öz-özidan anglatmaydi. Boşqaruv samaradorligi işlab çiqariş resurslaridan foydalaniş, xarajatlarni nazorat qiliş, mijozlarga qiymat yaratiş, xodimlar salohiyatini rivojlantiriş va pul oqimlarini muvofiqlaştiriş kabi özaro boğliq jarayonlar natijasida namoyon böladi.

Özbekiston Respublikasi Prezidentining 2025-yil 19-martdagi PF-50-son Farmonida kiçik va örta biznesning iqtisodiyotdagi örnini oşiriş, tadbirkorlik subyektlarining yiriklaşuvini rağbatlantiriş, yangi bozor segmentlariga çiqiş va innovatsiyalarni qöllab-quvvatlaş vazifalari belgilangan [1]. Bu çora-tadbirlarning korxona darajasidagi natijadorligi boşqaruv sifati, moliyaviy intizom va taşkiliy moslaşuvçanlikka bevosita boğliq.

Kiçik korxonalarda boşqaruvning öziga xosligi rahbarning bir vaqtning özida strategik, operatsion va moliyaviy vazifalarni bajarişida körinadi. Bunda qarorlar köpinça şaxsiy tajribaga tayanadi, faoliyatni doimiy ölçaş mexanizmlari yetişmaydi. Moliyalaştiriş manbalarining çeklanganligi, talab özgaruvçanligi va xodimlar kompetensiyasidagi tafovut uşbu muammoni yanada dolzarb qiladi.

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Mazkur tadqiqotning maqsadi kiçik biznes korxonalari boşqaruv samaradorligini oşirişga xizmat qiluvçi körsatkiçlar tizimi va uni joriy etişning taşkiliy-iqtisodiy mexanizmini ilmiy asoslaşdir. Tadqiqot doirasida milliy körsatkiçlar dinamikasi baholanadi, ilmiy yondaşuvlar umumlaştiriladi hamda moliya, mijozlar, içki jarayonlar va inson kapitalini birlaştiruvçi amaliy model işlab çiqiladi.

ADABIYOTLAR ŞARHI

Boşqaruv samaradorligini baholaş sohasidagi muhim yondaşuvlardan biri R. Kaplan va D. Norton taklif etgan Balanced Scorecard konsepsiyasidir. Unda korxona strategiyasini faqat moliyaviy körsatkiçlar bilan emas, balki mijozlar, içki jarayonlar hamda örganiş va rivojlaniş natijalari bilan birgalikda kuzatiş zarurligi asoslanadi [4]. Mazkur yondaşuv yirik taşkilotlar uçun yaratilgan bölsa-da, uning çeklangan sonli indikatorlarga asoslangan soddalaştirilgan şakli kiçik korxonalarga ham moslaştirilişi mumkin.

Iqtisodiy hamkorlik va taraqqiyot taşkilotining (OECD) 2024-yildagi tadqiqotida kiçik va örta korxonalarda raqamli vositalardan foydalaniş kengayayotgani, biroq yirik firmalar bilan raqamli tafovut saqlanib qolayotgani körsatiladi [5]. Raqamli texnologiyalarni örnatişning özi yetarli emas: ular hisob-kitoblar, buyurtmalar, zaxiralar va mijozlar munosabatlari haqidagi ma’lumotlardan boşqaruv qarorlarini işlab çiqişda foydalanilgandagina qiymat yaratadi.

OECDning 2023-yilgi şarhida kiçik biznesning moslaşuvçanligi va innovatsion imkoniyatlari xodimlarning texnik hamda boşqaruv könikmalariga boğliqligi ta’kidlanadi [6]. Jahon banki guruhining 2026-yilda e’lon qilingan Özbekiston xususiy sektori diagnostikasida esa moliyalaştiriş imkoniyatlari, soliq yukiga doir biznes xavotirlari va malaka tafovuti xususiy korxonalar ösişiga tösiq böluvçi omillar sifatida qayd etilgan [7].

Uşbu manbalarni umumlaştiriş şuni körsatadiki, kiçik biznesga nisbatan boşqaruv samaradorligini baholaş köp mezonli bölişi, biroq haddan taşqari murakkab hisobot tizimiga aylanmasligi lozim. Tadqiqotning taklif etilayotgan yangiligi köp mezonli konsepsiyani çeklangan ma’lumot va resurslarga ega kiçik korxonalar uçun ixçam, kuzatiladigan va bosqiçma-bosqiç qöllanadigan mexanizmga moslaştirişdan iborat.

TADQIQOT METODOLOGIYASI

Tadqiqot ikkilamçi ma’lumotlarga asoslangan nazariy-amaliy tahlil sifatida taşkil etildi. Ma’lumotlar bazasini Özbekiston Respublikasi Milliy statistika qömitasining SIAT körsatkiçlari, 2026-yildagi rasmiy statistik axborot, PF-50-son Farmon va nufuzli xalqaro taşkilotlar tadqiqotlari taşkil etdi [1–3, 5–7]. 2023–2025-

yillar uçun yillik körsatkiçlar dinamikasi tavsifiy tahlil qilindi; 2026-yil uçinçi çoragiga oid qiymatlar alohida, oraliq davr ma'lumoti sifatida talqin qilindi.

Metodologiyada uç yondaşuv qöllandi: birinçisi, dinamik va hududiy qiyoslaş orqali kiçik biznesning iqtisodiyotdagi örnini aniqlaş; ikkinçisi, tizimli yondaşuv yordamida korxona boşqaruvining özaro boğliq yönalişlarini ajratiş; uçinçisi, natijadorlik indikatorlarini tanlaş va joriy etişning taşkiliy algoritmini işlab çiqiş. Taklif etilayotgan integral indeks körsatkiçlarning maqsadga erişiş darajasini kuzatişga möljallangan diagnostik vositadir; u regressiya yoki eksperimental baholaş natijasi emas.

Tadqiqot çeklovi şundaki, alohida korxonalarning moliyaviy hisobotlari, sörovnomalari yoki tajriba ma'lumotlari mavjud emas. Şuning uçun makroiqtisodiy statistika asosida boşqaruv modelining aniq iqtisodiy samarasi yoki sabab-oqibat ta'siri haqida xulosa çiqarilmaydi. Modelni sinovdan ötkaziş keyingi empirik tadqiqotning alohida vazifasi sifatida belgilanadi.

NATIJALAR

Milliy statistika qömitasining SIAT ma'lumotlariga köra, kiçik tadbirkorlik subyektlarining yalpi içki mahsulotdagi uluşi 2023-yilda 53,8 foiz, 2024-yilda 53,5 foiz va 2025-yilda 52,2 foizni taşkil etgan. Namangan viloyatida ayni körsatkiçlar 74,0; 73,9 va 73,6 foiz bölgan [2]. Har ikki hududda uluşning pasayiş tendensiyasi kuzatilsa-da, mazkur özgarişlarning özi boşqaruv sifati yomonlaşganini isbotlamaydi: uluşga iqtisodiyotning boşqa segmentlaridagi ösiş sur'atlari va tarmoq tarkibi ham ta'sir etadi.

2026-yil III çorak böyiça SIAT tizimida respublika uçun 53,8 foiz, Namangan viloyati uçun 75,5 foiz körsatkiçi qayd etilgan [2]. Uşbu çoraklik ma'lumotlar 2025-yilning töliq yillik natijalari bilan töğridan-töğri soliştirilib, yillik ösiş sur'ati sifatida talqin qilinmaydi.

1-jadval. Kiçik tadbirkorlikning YaIMdagi uluşi (manba: SIAT [2])

Davr	Özbekiston, %	Namangan, %	Farq, foiz punkt
2023	53,8	74,0	20,2
2024	53,5	73,9	20,4
2025	52,2	73,6	21,4
2026-yil III çorak	53,8	75,5	21,7

Izoh: 2026-yil III çorak ma'lumoti yillik qatorga töğridan-töğri qoşilib, ösiş sur'ati sifatida talqin qilinmaydi.

2026-yil 1-iyul holatiga respublikada 1 236 126 ta kiçik tadbirkorlik subyekti faoliyat yuritgani ma'lum qilingan [3]. Uşbu umumiy son yuridik şaxs maqomidagi kiçik korxona va mikrofirmalar bilan bir qatorda yakka tartibdagi tadbirkorlar

hamda boşqa toifalarni qamrab oladi. Şu sababli uni faqat kiçik korxonalar soni sifatida körsatiş metodologik jihatdan notöğri böladi.

Kuzatilgan körsatkiçlar kiçik biznesning iqtisodiyotda salmoqli örin tutişini körsatadi. Biroq faoliyat kölami ortişi bilan korxonada operatsion nazorat, pul oqimini boşqariş, zaxiralarni rejalaştiriş va xizmat sifati monitoringi kabi vazifalar ham murakkablaşadi. Demak, hududiy va milliy rivojlantiriş siyosatini korxona içidagi boşqaruv salohiyatini mustahkamlaş bilan uyğunlaştiriş muhimdir.

Kiçik korxonalar uçun tahliliy jihatdan quyidagi muammo guruhlarini ajratiş mumkin: strategik maqsadlarning ölçab bölmasligi; byudjet va pul oqimlari rejasining nomuntazamligi; işlab çiqariş yoki xizmat körsatiş jarayonlarida yöqotişlarni qayd etmaslik; mijozlar bilan qayta aloqa tizimining zaifligi; xodimlar vazifalari va natijalarini baholaş mezonlarining noaniqligi. Bu tasnif tadqiqotda körib çiqilgan adabiyotlar va tizimli tahlil asosidagi konseptual umumlaştiriş bölib, korxonalar orasida uşbu muammolarning tarqaliş darajasi hisoblanmagan.

Tahlil asosida boşqaruv samaradorligini tört özaro boğliq yönalişda ölçaş taklif etiladi: (1) moliyaviy barqarorlik va rentabellik; (2) mijozlarga xizmat va bozor pozitsiyasi; (3) içki jarayonlar unumdorligi; (4) kadrlar salohiyati va raqamli boşqaruv. Bu tuzilma rahbarga daromad köpayişi bilan birga uning qanday xarajat va operatsion natijalar hisobiga ta’minlanganini ham köriş imkonini beradi.

BOŞQARUV SAMARADORLIGINI OŞIRIŞNING TAKLIF ETILAYOTGAN MODELI

Birinçi bosqiçda korxona missiyasi va 12 oylik maqsadlari aniq körsatkiçlarga ajratiladi. Masalan, korxona tuşumining ösişi yakuniy maqsad bölişi mumkin, ammo uni ta’minlovçi operatsion körsatkiçlar — buyurtmani bajariş muddati, takroriy xarid qiluvçi mijozlar uluşi va zaxira aylanmasi — alohida kuzatilişi kerak. Har bir indikatorning hisoblaş formulasi, mas’ul xodimi, ma’lumot manbasi va yangilaniş davri belgilanadi.

Ikkinçi bosqiçda haftalik operatsion hisobot va oylik moliyaviy körib çiqiş joriy etiladi. Haftalik yiğilişlarda işlab çiqariş yoki xizmat körsatişdagi oğişlar aniqlanadi, oylik tahlilda esa foyda marjasi, qarzdorlik, pul oqimi va mijozlar dinamikasi baholanadi. Körsatkiç böyiça salbiy oğiş kuzatilganida çora-tadbir, ijroçi va tekşiriş muddati bir hujjatda qayd etiladi.

2-jadval. Kiçik korxona uçun tavsiya etiladigan KPI tizimi (muallif işlanmasi)

Yönaliş	Asosiy körsatkiç	Hisoblaş va kuzatiş
Moliyaviy barqarorlik	Operatsion foyda marjasi; debitorlik muddati	Foyda / sof tuşum × 100; debitorlik qarzi / muddatli sotuv × davr kunlari

Yönaliş	Asosiy körsatkiç	Hisoblaş va kuzatiş
Mijozlar	Takroriy xarid uluşi; şikoyatlarni hal etiş muddati	Qayta xarid qilgan mijozlar / jami mijozlar × 100; örtaça kun
Ichki jarayonlar	Buyurtma sikli; nuqsonlar uluşi	Buyurtma başlanişidan yakunigaça vaqt; nuqsonli mahsulotlar / jami işlab çiqarilgan mahsulotlar × 100
Inson kapitali va raqamli tizim	Xodim başiga tuşum; raqamli qayd uluşi	Tuşum / örtaça xodimlar soni; tizimda qayd etilgan operatsiyalar / jami operatsiyalar × 100

Uçinçi bosqiçda indikatorlar böyiça integral diagnostik baho şakllantirilişi mumkin. Har bir i-indikatorning maqsadga erişiş darajasi s_i (0 dan 100 ballgaça), yönaliş vazni esa w_i deb belgilansa, umumlaştirilgan baho $S = \Sigma(w_i \times s_i)$ körinişida hisoblanadi; bunda $\Sigma w_i = 1$. «Köp bölsa yaxşi» turidagi körsatkiçlar uçun $s_i = \min(100; 100 \times X_i/T_i)$, «kam bölsa yaxşi» turidagi körsatkiçlar uçun $s_i = \min(100; 100 \times T_i/X_i)$ formulasi qöllanadi. Bu yerda X_i — amaldagi natija, T_i — musbat maqsad qiymati. Nol qiymatlar, çegaraviy holatlar va turli sektorlar uçun istisnolar baholaş reglamentida alohida belgilanişi zarur.

Soddalaştirilgan taşkiliy variantda moliyaviy yönalişga 0,30, mijozlarga 0,25, jarayonlarga 0,25, kadrlar va raqamlaştirişga 0,20 vazn ajratiş mumkin. Mazkur vaznlar ilmiy kuzatuv natijasida aniqlangan koeffitsiyentlar emas, balki dastlabki boşqaruv qarorlari uçun tavsiya etilayotgan misoldir. Ular tarmoq xususiyati, korxona strategiyasi va mutaxassislar bahosiga qarab qayta kalibrlanişi kerak. Bundan taşqari, umumiy bahoning yuqoriligi pul oqimidagi xavfli uzilişni yaşirmasligi uçun kritik körsatkiçlar böyiça alohida minimal talablar belgilanişi lozim.

Raqamlaştiriş törtinçi yordamçi mexanizm emas, barça yönalişlarni boğlovçi infratuzilma sifatida qaraladi. Masalan, elektron hisob-kitob va zaxira qaydlari xarajatlarning şakllanişini, mijozlar bazasi takroriy xaridlarni, xodim vazifalarini qayd etiş tizimi esa javobgarlikni körsatadi. Dastur tanlaşda qimmat tizimlarni xarid qilişdan köra ma’lumot sifati, foydalanuvçi qulayligi, axborot xavfsizligi va joriy etiş xarajatlari birinçi öringa qöyiladi.

Taqdim etilgan modelning iqtisodiy samarasi korxona darajasida quyidagi yöllar orqali namoyon bölişi kutiladi: ortiqça zaxiralarning kamayişi, takroriy operatsiyalarni qisqartiriş, iş vaqti yöqotişlarini aniqlaş, debitorlik qarzini tezroq undiriş va mijozlarni saqlab qoliş. Biroq aniq foiz yoki puldagi natija faqat korxonaning bazaviy va keyingi davr ma’lumotlari asosida baholanişi mumkin.

AMALIY JORIY ETIŞ BOSQIÇLARI

Modelni joriy etişning dastlabki 30 kunida korxona rahbari mavjud hisob ma'lumotlari, vazifalar taqsimoti va asosiy operatsiyalarni xaritalaydi. Uşbu davrda har bir indikatorning boşlanğiç qiymati belgilanadi, bir xil nomdagi ma'lumotlarning turli manbalardagi farqlari aniqlanadi. Keyingi 30 kunda hisob yuritiş tartibi yagona şaklga keltiriladi va rahbar uçun qisqa körsatkiçlar paneli tuziladi.

Uçinçi 30 kun içida tanlangan bitta jarayonda, masalan, buyurtmalarni bajariş yoki zaxiralarni boşqarişda, sinov loyihasi ötkaziladi. Iş boşlanişidan oldingi va keyingi körsatkiçlar bir xil usulda ölçanadi. Agar mavsumiylik yoki narx özgarişi kuçli bölsa, faqat «oldin–keyin» qiyosi yetarli bölmasligi mumkin; imkon bölsa öxşaş bölinma yoki taqqoslanadigan davr bilan nazorat qiyosi taşkil etiladi.

3–12 oy davomida natija bergan usullar boşqa jarayonlarga yoyiladi. Xodimlarning KPI körsatkiçlari jazolaşning mexanik vositasiga aylantirilmaydi, balki trening, rağbatlantiriş va jarayonni yaxşilaş uçun işlatiladi. Rahbarlik vakolatlarini bosqiçma-bosqiç taqsimlaş, örinbosarlarni tayyorlaş va qarorlar jurnalini yuritiş biznesning faqat bir şaxsga boğlanib qoliş xavfini kamaytiradi.

Mintaqaviy amaliyot, jumladan Namangan viloyatidagi korxonalar uçun, savdo, xizmat va işlab çiqariş subyektlarini bir xil maqsad darajalari bilan baholamaslik tavsiya etiladi. Ularning faoliyat sikllari va kapital siğimi farq qilgani sababli körsatkiçlar tarmoq xususiyatiga moslaştirilişi zarur. Korxonalarni qöllab-quvvatlovçi taşkilotlar tomonidan qisqa boşqaruv diagnostikasi, mentorlik va raqamli hisob yuritiş böyiça amaliy maslahatlar beriş uşbu yondaşuvni kengaytirişi mumkin.

MUHOKAMA

Tahlil şuni körsatadiki, kiçik biznesni boşqariş samaradorligini faqat sof foyda yoki savdo hajmi bilan ifodalaş bir yoqlama yondaşuvdir. Qisqa muddatda tuşumning ösişi pul oqimlari yetişmovçiligi, mijozlarning ketişi yoki mahsulot sifati pasayişi hisobiga yuz berişi ham mumkin. Şuning uçun moliyaviy va nomoliyaviy körsatkiçlarni özaro boğlaş strategik ahamiyat kasb etadi.

Taklif etilayotgan modelning ustunligi — indikatorlar sonini çeklaş, hisobot davrlarini aniqlaştiriş va strategik qaror bilan operatsion jarayon örtasida kuzatiladigan boğlaniş örnatişidir. Biroq kiçik korxonalarda ma'lumotlarning töliq yuritilmasligi, xodimlarda raqamli könikmalarning yetişmasligi yoki rahbar tomonidan körsatkiçlarni subyektiv tanlaş modelni joriy etiş sifatiga salbiy ta'sir qilişi mumkin. Şuningdek, vaznlar va maqsad darajalarini notöğri belgilaş baholaş natijasini çalğitadi.

Kelgusi empirik işlar uçun bir neçta tarmoqdagi kiçik korxonalarni kamida 6–12 oy kuzatiş, modelni joriy etgan va etmagan korxonalar dinamikasini soliştiriş maqsadga muvofiq. Bu jarayonda mehnat unumdorligi, operatsion foyda marjasi, buyurtma sikli va mijozlarni saqlaş darajasi natijaviy indikatorlar sifatida olinişi mumkin. Şundagina taklif etilgan mexanizmning samarasi va qöllaş çegaralari statistik usullar orqali tekşiriladi.

XULOSA VA TAKLIFLAR

Kiçik biznes korxonalarini boşqariş samaradorligini oşirişning asosiy şarti — strategik maqsadlarni ölçab böladigan operatsion natijalarga aylantirişdir. Rasmiy statistik ma’lumotlar Özbekistonda, xususan Namangan viloyatida kiçik tadbirkorlikning iqtisodiy ahamiyati yuqoriligini tasdiqlaydi, biroq makroiqtisodiy uluş korxona boşqaruvi sifatining bevosita ölçovi emas.

Tadqiqot natijasida törtta yönalişga asoslangan boşqaruv samaradorligi modeli taklif etildi: moliyaviy barqarorlik; mijozlar bilan munosabatlar; içki jarayonlar; inson kapitali va raqamli boşqaruv. Taklifning amaliy qiymati indikatorlarni hisoblaş, mas’ullarni belgilaş, muntazam hisobot yuritiş, salbiy oğişlarga javob çoralarini tanlaş hamda boşqaruv qarorlarini tekşiriladigan ma’lumotga asoslaş imkoniyatidadir.

Amaliy jihatdan kiçik korxonalarda 90 kunlik diagnostika va sinov bosqiçini yölga qöyiş, pul oqimi va xarajatlar nazoratini ustuvorlaştiriş, mijozlardan muntazam qayta aloqa oliş, xodimlar malakasini oşiriş va raqamli hisob tizimlarini izçil joriy etiş tavsiya etiladi. Taklif etilgan mexanizmning natijadorligini ilmiy tasdiqlaş uçun korxona darajasidagi birlamçi ma’lumotlar asosida alohida empirik baholaş zarur.

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FARG‘ONA VILOYATIDA KICHIK BIZNESNI RAQAMLASHTIRISHNING IQTISODIY IMKONIYATLARI, MAVJUD MUAMMOLARI VA RIVOJLANTIRISH YO‘NALISHLARI

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Annotatsiya. *Tezisda Farg‘ona viloyatida kichik tadbirkorlikning tarmoq va hududiy ko‘rsatkichlari tahlil qilinib, korxonalarni raqamlashtirishning amaliy ustuvorliklari aniqlanadi. Xalqaro tadqiqotlar asosida raqamli ko‘nikmalar, infratuzilma, xarajatlar va axborot xavfsizligi bilan bog‘liq xatarlar tasniflanadi hamda kichik biznes uchun bosqichli qo‘llab-quvvatlash mexanizmi taklif etiladi.*

Kalit so‘zlar: *Farg‘ona viloyati, kichik tadbirkorlik, raqamli infratuzilma, raqamli ko‘nikmalar, elektron tijorat, hududiy rivojlanish*.

Kirish

Raqamlashtirish kichik biznes uchun bozorlarga kirish, mijozlarga xizmat ko‘rsatish va operatsion boshqaruvni takomillashtirish imkoniyatlarini kengaytiradi. Shu bilan birga, raqamli yechimlardan olinadigan iqtisodiy foyda tarmoq xususiyati, korxona hajmi va xodimlarning tayyorgarlik darajasiga qarab farqlanadi. OECD [1] kichik firmalarning texnologiya, malaka va moliyalashtirish bo‘yicha cheklovlarini raqamli tafovut omillari sifatida qayd etadi. Shu nuqtayi nazardan Farg‘ona viloyati misolida raqamlashtirish ustuvorliklarini aniqlash dolzarbdir.

Metodologiya va ma’lumotlar

Tadqiqot rasmiy hududiy statistika, OECDning tahliliy hisoboti va raqamli transformatsiya bo‘yicha ilmiy adabiyotlar asosidagi ikkilamchi ma’lumotlar tahliliga tayanadi. Statistika boshqarmasining 2025-yil 28-oktabrda e’lon qilingan yanvar–sentabr hisobotidan korxona soni, yangi tashkil etilgan subyektlar va sanoat ko‘rsatkichlari olindi [2]. Raqamlashtirish darajasi bo‘yicha hududiy

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mikroma’lumotlar mavjud bo‘lmagani sababli muammolar aniqlangan mahalliy faktlar emas, tekshirilishi lozim bo‘lgan ehtimoliy to‘siqlar sifatida talqin qilinadi.

Hududiy iqtisodiy holat tahlili

Farg‘ona viloyatida 2025-yil 1-oktabrda 30 427 ta faol kichik korxona va mikrofirma qayd etilgan. 2025-yil yanvar–sentabr oylarida 4 920 ta yangi kichik korxona va mikrofirma tashkil etilgan bo‘lib, 2024-yilning ayni davrida bu ko‘rsatkich 4 879 tani tashkil etgan. Yangi tashkil etilganlar sonidagi mutlaq farq 41 ta, nisbiy o‘sish esa taxminan 0,8 foizga teng (muallif hisob-kitobi: 41/4 879 × 100) [2]. Bu natija korxonalar tugatilishi yoki faoliyat davomiyligini emas, faqat yangi tashkil etilish oqimini tavsiflaydi.

2025-yil yanvar–sentabrida viloyat kichik tadbirkorligi 22 816,8 mlrd so‘mlik sanoat mahsulotini ishlab chiqarib, jami sanoat ishlab chiqarishining 56,1 foizini ta’minlagan [2]. 2025-yil yanvar–noyabrida esa kichik tadbirkorlik subyektlari tomonidan ko‘rsatilgan bozor xizmatlari 46 131,8 mlrd so‘mga yetib, bozor xizmatlari umumiy hajmining 74,5 foizini tashkil qilgan [3]. Hisobot davrlari turlicha bo‘lgani uchun bu ikki hajmni bevosita taqqoslab, o‘sish xulosasini chiqarish metodologik jihatdan to‘g‘ri emas.

1-jadval. Farg‘ona viloyatida kichik biznesning ayrim ko‘rsatkichlari

Ko‘rsatkich	Qiymat	Hisobot davri
Faol kichik korxona va mikrofirmalar	30 427 ta	2025-yil 1-oktabr
Yangi tashkil etilgan korxonalar	4 920 ta	2025-yil yanvar–sentabr
Kichik biznes sanoat mahsuloti	22 816,8 mlrd so‘m	2025-yil yanvar–sentabr
Kichik biznesning sanoatdagi ulushi	56,1 %	2025-yil yanvar–sentabr
Kichik tadbirkorlik bozor xizmatlari	46 131,8 mlrd so‘m	2025-yil yanvar–noyabr

Manba: Farg‘ona viloyati statistika boshqarmasi [2, 3].

Raqamlashtirish imkoniyatlari va cheklovlari

Viloyat kichik korxonalarining tarmoq tuzilmasini e’tiborga olgan holda savdoda elektron tijorat platformalari, xaridorlar bazasini boshqarish va elektron to‘lovlarni integratsiyalash; sanoatda esa ombor va ishlab chiqarish hisobini avtomatlashtirish; xizmatlar sohasida onlayn bronlash, raqamli reklama va xizmat sifatini baholash vositalariga ustuvor ahamiyat berish mumkin. Bular hududning iqtisodiy tarkibi hamda xalqaro adabiyotdan kelib chiqadigan amaliy takliflardir, kuzatilgan joriy etish darajasini ifodalamaydi.

OECD [1] ma’lumotlariga ko‘ra, kichik firmalarning raqamli transformatsiyasiga infratuzilma va moliyaviy resurslarning cheklanganligi, ichki raqamli kompetensiya yetishmasligi, ma’lumotlarni boshqarish hamda kiberxavfsizlik xatarlari to‘sqinlik qilishi mumkin. Vial [4] tashkiliy o‘zgarish va biznes-model moslashuvini raqamli transformatsiyaning muhim sharti sifatida

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ko‘rsatadi. Farg‘onada ushbu omillarning qaysi biri ustuvorligini aniqlash uchun sohaviy va tumanlar kesimidagi maqsadli so‘rov zarur.

Amaliy takliflar

Birinchidan, tarmoq va korxona hajmini hisobga oladigan qisqa raqamli tayyorgarlik diagnostikasi ishlab chiqilishi lozim. Ikkinchidan, savdo va xizmat ko‘rsatish subyektlari uchun elektron savdo, hisob-kitob va CRM bo‘yicha qisqa modulli o‘quv kurslarini tashkil etish maqsadga muvofiq. Uchinchidan, sanoat mikrofirmalarida ombor hisobini yuritish va xarajatlarni kuzatish bo‘yicha arzon, bulutli yechimlarni sinovdan o‘tkazish mumkin. To‘rtinchidan, tanlangan korxonalarda pilot loyiha boshlanishidan oldin va keyin xarajat, buyurtmani bajarish vaqti, tushum va rentabellik ko‘rsatkichlarini qayd etish zarur.

Pilot dastur samaradorligini tekshirishda raqamli yechim joriy etgan korxonalar natijalari o‘xshash, lekin joriy etmagan korxonalar bilan qiyoslanishi mumkin. Bunda korxona miqyosi, faoliyat turi, hudud va boshlang‘ich moliyaviy holat singari omillar nazorat qilinishi talab etiladi. Bunday yondashuv tavsiyalarning iqtisodiy asoslanganligini kuchaytiradi.

Xulosa

Farg‘ona viloyatidagi rasmiy statistika kichik biznesning sanoat va xizmatlar bozoridagi muhim o‘rnini tasdiqlaydi. Raqamlashtirish uchun eng istiqbolli yo‘nalishlar korxonalarning amaldagi biznes-jarayonlariga mos, o‘lchash mumkin bo‘lgan natija beruvchi yechimlarni tanlash bilan bog‘liq. Raqamli ko‘nikmalarni rivojlantirish, arzon texnologiyalar va natijadorlik monitoringini birlashtirgan bosqichli yondashuv hududiy kichik biznes siyosatining amaliy yo‘nalishi bo‘lishi mumkin. Mazkur xulosalar ikkilamchi ma’lumotlar asosidagi tahliliy tavsiyalar bo‘lib, korxona darajasidagi empirik tekshirishni talab qiladi.

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6. MEDICINE, PHARMACY AND BIOTECHNOLOGY: CONTEMPORARY RESEARCH AND PROSPECTS FOR A HEALTHY SOCIETY.

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QURUQ EKSTRAKT ASOSIDAGI GIDROGELNING TARKIBINI ASOSLAŞ VA UNI STERIL HOLDA OLIŞ TEXNOLOGIYASI

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Annotatsiya. *Tezisda quruq ekstrakt asosida olingan gidrogel tarkibi va texnologiyasini işlab çiqiş masalasi diabetik oyoq yaralariga möljallangan, aççiq şuvoq (Artemisia absinthium L.) quruq ekstrakti tutgan "Artabsin" gidrogeli misolida körib çiqilgan. Ekstrakt uluşi 5 % deb belgilandi, karbomer 940 (1,0 %), propilenglikol (10 %) va glitserin (5 %) tutgan, pH 5,5–6,0 gaça neytrallangan asos tanlandi. Oçiq yaraga qöllanişini hisobga olib, gelni steril holda işlab çiqarişni nazarda tutuvçi texnologik sxema va sifat körsatkiçlari taklif etildi.*

Kalit sözlar: *diabetik oyoq yarasi, aççiq şuvoq, quruq ekstrakt, "Artabsin" gidrogeli, karbomer, sterillik.*

Аннотация. *В тезисе рассмотрена разработка состава и технологии гидрогеля на основе сухого экстракта на примере гидрогеля «Артабсин», содержащего сухой экстракт полыни горькой (Artemisia absinthium L.) и предназначенного для лечения диабетических язв стопы. Содержание экстракта принято равным 5 %, выбрана основа из карбомера 940 (1,0 %), пропиленгликоля (10 %) и глицерина (5 %), нейтрализованная до pH 5,5–6,0. С учётом применения на открытую рану предложены технологическая схема получения стерильного геля и показатели качества.*

Ключевые слова: *диабетическая язва стопы, полынь горькая, сухой экстракт, гидрогель «Артабсин», карбомер, стерильность.*

Abstract. *The thesis addresses the development of the composition and technology of a hydrogel based on dry extract, using as an example "Artabsin", a hydrogel containing dry extract of wormwood (Artemisia absinthium L.) intended for the treatment of diabetic foot ulcers. The extract content was set at 5%, and a base of carbomer 940 (1.0%), propylene glycol (10%) and glycerol (5%) neutralised to pH 5.5–6.0 was selected. Since the gel is applied to open wounds, a process flow for a sterile product and quality parameters are proposed.*

Keywords: *diabetic foot ulcer, wormwood, dry extract, Artabsin hydrogel, carbomer, sterility.*

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Kiriş. Xalqaro diabet federatsiyasining 2025-yilgi ma'lumotiga köra, dunyoda 20–79 yoşdagi 589 million kişi qandli diabet bilan yaşaydi [1]. Diabet bilan oğrigan bemorlar orasida oyoq yarasining global tarqalişi 6,3 % ni taşkil etadi [2], bitgan yaralar esa köpinça qaytalanadi [3]. Bu yaralarga qöşilgan infeksiyalardan eng köp *Staphylococcus aureus* ajratilgan, uning 18,0 % i metitsillinga çidamli ştammlar bölgan [4]. Cochrane şarhida gidrogel boğlamalar oddiy kontakt boğlamalarga nisbatan diabetik oyoq yaralarining bitişini köproq ta'minlagan (nisbiy xavf 1,80; 95 % IO 1,27–2,56), ammo dalillar sifati past baholangan [5]. Aççiq şuvoq (*Artemisia absinthium* L.) an'anaviy tibbiyotda qiyin bitadigan yaralarni davolaşda işlatilgan; uning tarkibida efir moyi, seskviterpen laktonlar, flavonoidlar va fenol kislotalar mavjud [6]. Özbekiston Respublikasi Prezidentining 2020-yil 10-apreldagi PQ-4670-son qarorida mahalliy dorivor ösimliklarni çuqur qayta işlaş vazifasi qöyilgan [7]. **Tadqiqot maqsadi:** quruq ekstrakt asosida olingan gidrogel tarkibi va texnologiyasini işlab çiqiş; obyekt sifatida aççiq şuvoq quruq ekstrakti tutgan "Artabsin" gidrogeli olindi.

Materiallar va metodlar. Tadqiqot obyekti: aççiq şuvoq ötining suv-spirtli quruq ekstrakti va uning asosida loyihalangan "Artabsin" gidrogeli. *A. absinthium* ekstraktlarining fitokimyoviy tarkibi, antimikrob faolligi va xavfsizligi, şuningdek ösimlik ekstraktlari tutgan karbomerli gellarning fizik-kimyoviy körsatkiçlari böyiça çop etilgan eksperimental ma'lumotlar tahlil qilindi. Gel hosil qiluvçi sifatida karbomer 940, köp atomli spirtlar sifatida propilenglikol va glitserin, neytrallovçi sifatida trietanolamin (TEA), konservantlar sifatida metil- va propil-parahidroksibenzoatlar olindi. Sifat talablari Yevropa farmakopeyasining teriga qöllaniladigan yumşoq dori şakllari monografiyasi asosida belgilandi [8]. Sinov usullari sifatida pH, qovuşqoqlik (rotatsion viskozimetriya), surtiluvçanlik, kolloid va termik barqarorlik, in vitro ajraliş (Franz yaçeykasi, 32 °C), sterillik hamda umumiy fenol birikmalari va xlorogen kislota miqdori (spektrofotometriya, YuSSX) tanlandi.

Natijalar. Metanolli quruq ekstraktda eng köp polifenol xlorogen kislota bölib, 3,75 g/100 g ni taşkil etgan; ekstrakt *S. aureus* ga 0,31–0,625 mg/ml, *Escherichia coli* ga 1,25–2,5 mg/ml minimal ingibirlovçi konsentratsiyada (MIK) ta'sir qilgan, hayvonlarda ötkir teri orqali va peroral toksiklik aniqlanmagan [9]. Etanolli ekstrakt 400 mkg/ml gaça konsentratsiyada HaCaT keratinotsitlariga sitotoksik bölmagan [10]. Şunday qilib, ekstrakt diabetik oyoq infeksiyalarida eng köp ajratiladigan qözğatuvçiga [4] *E. coli* ga qaraganda taxminan 4 marta past konsentratsiyada ta'sir qiladi. Kalamuşlardagi yara modelida statistik işonçli samarani 10 % li malham bergan [9]. Aççiq şuvoq ekstrakti kinnamaldegid va kislorod manbai bilan birga qöllangan ikki qavatli boğlama Gram-musbat va Gram-manfiy mikroorganizmlar

ösişini töxtatgan [11], biroq bu samarani faqat aççiq şuvoqqa boğlab bölmaydi. Şu ma'lumotlar asosida gelda ekstrakt uluşi 5 % (MIK ning yuqori çegarasidan taxminan 80 marta ortiq) deb qabul qilindi, 10 % li muqobil tarkib esa taqqoslaş uçun qoldirildi.

1,0 % karbomer va 10 % propilenglikol tutgan ösimlik gellarida maqbul qovuşqoqlik va tiksotropiya kuzatilgan, ekstraktlar ajralişi 85,78–87,36 % ga yetgan va gellar 12 oy barqaror bölgan [12]; karbomer uluşi ortişi bilan esa qovuşqoqlik oşib, surtiluvçanlik pasaygan [13]. Natijada "Artabsin" gidrogelining quyidagi tarkibi (100,0 g ga) taklif etildi: aççiq şuvoq quruq ekstrakti 5,0; karbomer 940 1,0; propilenglikol 10,0; glitserin 5,0; metil-parahidroksibenzoat 0,15; propil-parahidroksibenzoat 0,05; trietanolamin pH 5,5–6,0 gaça; tozalangan suv 100,0 gaça. Texnologik jarayon: konservantlarni propilenglikolda 50–60 °C da eritiş; karbomerni suvning 70 % qismida dispersiyalab, 12–24 soat böktiriş; quruq ekstraktni qolgan suv va glitserinda 40–45 °C da eritib, elakdan ötkaziş; eritmalarni karbomer dispersiyasiga qöşiş; TEA bilan neytrallaş; gomogenizatsiya va vakuum ostida havosizlantiriş; sterillaş yoki aseptik şaroitda tubalarga qadoqlaş. Tayyor gel uçun pH 5,0–6,0, qovuşqoqlik 10 000–20 000 mPa·s, surtiluvçanlik 5–7 sm loyihaviy me'yorlar sifatida belgilandi.

Muhokama. Ekstrakt karbomer dispersiyasiga neytrallaşdan oldin kiritiladi, şunda TEA miqdori ekstrakt tarkibidagi organik kislotalarni hisobga olgan holda pH böyiça titrlanadi. Yevropa farmakopeyasiga köra, oğir şikastlangan teriga qöllaniladigan yumşoq dori şakllari steril böladi [8]; diabetik oyoq yarasi oçiq yara bölgani uçun "Artabsin" ham steril holda çiqarilişi kerak. Sterillaş usulining gel qovuşqoqligi va polifenollar miqdoriga ta'siri tajribada baholanadi. Butun teri yuzasining pH qiymati örtaça 5 dan past [14], yara bitişining turli bosqiçlari uçun esa turli pH oraliqlari qulay [15]; şu sababli tanlangan pH 5,0–6,0 oraliğining yara bitişiga ta'siri alohida örganiladi. Gel antibiotik terapiyasining örnini bosmaydi: infeksiyalangan diabetik yaralar yöriqnoma asosida davolanadi [16]. Efir moyida α-tuyon aniqlangani [17] va efir moyini uzoq muddat qöllaş toksik ta'sir körsatişi mumkinligi [18] sababli gelda tuyon miqdorini nazorat qiliş tavsiya etiladi. Quruq ekstrakt va gelni umumiy fenollar hamda xlorogen kislota böyiça standartlaş taklif etiladi.

Xulosa. Çop etilgan ma'lumotlar aççiq şuvoq quruq ekstraktining polifenollarga boyligi, diabetik oyoq infeksiyalarida eng köp ajratiladigan *S. aureus* ga nisbatan faolligi va past toksikligini körsatadi. 5 % quruq ekstrakt, 1,0 % karbomer 940, 10 % propilenglikol va 5 % glitserin tutgan, pH 5,5–6,0 gaça neytrallangan "Artabsin" gidrogeli tarkibi va steril mahsulot olişni nazarda tutuvçi texnologik sxema taklif etildi. Keyingi bosqiçda gelning fizik-kimyoviy

körsatkiçlari, barqarorligi va eksperimental diabetik yara modelidagi samaradorligi baholanadi.

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THE STATE OF NADPH–CYTOCHROME P-450 REDUCTASE ACTIVITY IN HEPATOCYTE MICROSOMES UNDER THE ACTION OF INDUCERS AND INHIBITORS OF THE MONOOXYGENASE AND NO SYSTEMS

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Abstract. *The interaction between the hepatic microsomal monooxygenase system and nitric oxide metabolism plays an important role in the regulation of xenobiotic biotransformation, oxidative stress, and cellular adaptation. This study aimed to investigate the potential regulatory role of NADPH–cytochrome P450 reductase as a functional link between the monooxygenase and nitrergic systems in rat liver microsomes under the influence of specific inducers and inhibitors.*

Keywords: *NADPH–cytochrome P450 reductase; NADPH–cytochrome c reductase; cytochrome P450; liver microsomes; monooxygenase system; nitric oxide; endothelial nitric oxide synthase; inducible nitric oxide synthase; peroxynitrite; benzonal; cimetidine; Hepa-Merz; L-NAME; oxidative stress; xenobiotic metabolism.*

Introduction

The hepatic microsomal monooxygenase system (MOS) plays a crucial role in the metabolism of xenobiotics and endogenous compounds. Its activity depends primarily on cytochrome P450 enzymes and NADPH–cytochrome P450 reductase, which participate in electron transfer and oxidative biotransformation processes .

The nitrergic system, represented by nitric oxide (NO) and nitric oxide synthases (eNOS and iNOS), is involved in the regulation of cellular metabolism, oxidative stress, and adaptive responses. Nitric oxide can interact with cytochrome P450 enzymes, modifying their catalytic activity and influencing hepatic detoxification processes [3–6]. Excessive NO production may also promote peroxynitrite ($ONOO^-$) formation, contributing to oxidative and nitrosative damage .

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Both monooxygenase and nitrergic systems rely on NADPH-dependent electron transfer, suggesting a possible functional relationship between them. NADPH–cytochrome P450 reductase may play an important regulatory role in microsomal oxidation, although the mechanisms linking these systems remain insufficiently understood .

Aim. To establish the trigger role of NADPH–cytochrome P-450 reductase in liver microsomes as a link between the nitrergic and monooxygenase systems under the action of specific inducers and inhibitors of these systems.

Material and methods. Sexually mature outbred male rats of a mixed population weighing 180–240 g were used. The experiments were carried out in four groups. Group 1 comprised animals given a 2% aqueous suspension of benzonal at 50 mg/kg; group 2, a 0.5% aqueous solution of cimetidine at a dose of 10 mg/kg; group 3, a 1% aqueous solution of Hepa-Merz at 30 mg/kg; and group 4, a 0.1% aqueous suspension of L-NAME at 5 mg/kg. Each experimental group consisted of 6–8 animals. The preparations were administered intragastrically by gavage for 10 consecutive days. In the microsomal pellet (obtained at 105,000 g), the microsomal enzymes were determined — cytochromes (cyt.) P-450, P-420 and b_5, and the activities of NADPH–cytochrome c reductase (an analogue of NADPH–cytochrome P-450 reductase), aminopyrine N-demethylase (N-AD), aniline hydroxylase (AH) and glucose-6-phosphatase (G-6-Pase) — together with indices characterising the nitrergic system: the concentration of nitric oxide (NO), assessed as the sum of its principal stable metabolites NO_2^- and NO_3^-, the activities of endothelial NO synthase (eNOS) and inducible NO synthase (iNOS), and the concentration of peroxynitrite ($ONOO^-$). The data obtained was put into statistical analysis; differences were considered significant at $p \leq 0.05$.

Results. Benzonal, an inducer of drug metabolism, produced a statistically significant increase in all the studied indices of the monooxygenase system (MOS) — with the exception of cyt. P-420 — in microsomes isolated from rat liver. At the same time, an increase in eNOS activity (by 24.5%, $p < 0.01$) and in NO concentration (by 19.6%, $p < 0.05$) was noted, against a background of a slight ($p > 0.05$) decrease in iNOS activity (by 3.9%) and in $ONOO^-$ formation (by 4.5%). In contrast, cimetidine — an inhibitor of the MOS — reduced the content of the principal microsomal enzymes, with the exception of cyt. P-420 and NADPH–cytochrome c reductase, and led to a marked increase in NO expression (by 44.2%, $p < 0.001$), iNOS activity (by 28.9%, $p < 0.01$) and $ONOO^-$ level (by 39.6%, $p < 0.001$), against a background of a reduced rate of the enzymatic reaction of eNOS (by 30.1%, $p < 0.01$). Hepa-Merz, an indirect stimulator of the nitrergic system, affected the activity of the microsomal oxidation enzymes in a manner similar to the

MOS inducer benzonal, but to a lesser extent — by 10.0–16.1% ($p < 0.05$) — while its effect on the activity of the NO system was equivocal. The indirect inhibitor of the NO system L-NAME, meanwhile, stimulated the rise in cyt. P-420 concentration and in NADPH–cytochrome c reductase activity to a greater degree than did the MOS inhibitor cimetidine, against a background of a moderate decrease in the activities of the other MOS enzymes studied; it also increased the indices of the NO system — NO by 30.5% ($p < 0.01$), iNOS by 34.8% and $ONOO^-$ by 47.5% — and suppressed eNOS activity by 29.1% ($p < 0.01$).

Correlation analysis revealed a strong direct relationship ($r = 0.86–0.93$) between NADPH–cytochrome c reductase and the principal indices of the hepatic MOS — cyt. P-450, cyt. b_5, AH, N-AD and G-6-Pase (with the exception of cyt. P-420) — under the action of the microsomal oxidation inducer benzonal, as well as with NO ($r = 0.84$) and eNOS ($r = 0.82$), together with a weak ($p > 0.1$) inverse relationship with the parameters of iNOS and $ONOO^-$. The activity of NADPH–cytochrome c reductase showed a strong inverse relationship ($r = -0.79$ to -0.86) with the microsomal enzymes and with eNOS activity ($r = -0.85$), and a strong direct relationship ($r = 0.83–0.90$) with cyt. P-420 and with the parameters of the NO system — NO, iNOS and $ONOO^-$. With the use of the indirect eNOS inducer Hepa-Merz, NADPH–cytochrome c reductase showed a correlation ($r = 0.62–0.71$) with the MOS parameters, i.e. of the same direction as that observed with administration of the MOS inducer benzonal; whereas with administration of the indirect NO-system inhibitor L-NAME, a distinct trend in the correlation coefficient of NADPH–cytochrome c reductase was preserved ($r = 0.71–0.86$), as with administration of the MOS inhibitor cimetidine.

Conclusions. Administration of inducers and inhibitors of the MOS and of the NO system gives rise to competitive relationships in liver microsomes for the utilisation of NADPH–cytochrome c reductase in oxidative processes. This enzyme apparently plays a key role in the reactions that limit the processes of cellular adaptation to the action of xenobiotics and environmental factors.

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DEVELOPMENT OF THE COMPOSITION AND TECHNOLOGY OF "ARTABSIN" GEL BASED ON DRY EXTRACT

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Abstract. *The article addresses the development of the composition and technology of a hydrogel based on dry extract, using as an example "Artabsin", a hydrogel containing dry extract of wormwood (Artemisia absinthium L.) intended for the topical treatment of diabetic foot ulcers; the rationale is based on published experimental data. The polyphenol composition, antimicrobial activity and safety of the extract, as well as the physicochemical parameters of carbomer gels with plant extracts, were analysed. Given the minimum inhibitory concentration of the extract against Staphylococcus aureus, the organism most often isolated from diabetic foot infections (0.31–0.625 mg/mL), its content in the gel was set at 5%. A base of 1.0% carbomer, 10% propylene glycol and 5% glycerol neutralised to pH 5.5–6.0, a nine-stage process flow and draft specifications for a sterile gel are proposed.*

Keywords: *diabetic foot ulcer, wormwood, dry extract, Artabsin hydrogel, carbomer, process flow, sterility, standardisation.*

Аннотация. *В статье рассмотрена разработка состава и технологии гидрогеля на основе сухого экстракта на примере гидрогеля «Артабсин», содержащего сухой экстракт полыни горькой (Artemisia absinthium L.) и предназначенного для местного лечения диабетических язв стопы; обоснование выполнено по опубликованным экспериментальным данным. Проанализированы полифенольный состав, антимикробная активность и безопасность экстракта, а также физико-химические показатели карбомерных гелей с растительными экстрактами. С учётом минимальной ингибирующей концентрации экстракта в отношении Staphylococcus aureus, наиболее частого возбудителя инфекций диабетической стопы (0,31–0,625 мг/мл), его содержание в геле принято равным 5 %. Предложены основа из 1,0 % карбомера, 10 % пропиленгликоля и 5 % глицерина, нейтрализованная до pH 5,5–6,0, девятистадийная технологическая схема и проект норм качества стерильного геля.*

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Ключевые слова: *диабетическая язва стопы, полынь горькая, сухой экстракт, гидрогель «Артабсин», карбомер, технологическая схема, стерильность, стандартизация.*

Annotatsiya. *Maqolada quruq ekstrakt asosida olingan gidrogel tarkibi va texnologiyasini işlab çiqiş masalasi diabetik oyoq yaralarini mahalliy davolaşga möljallangan, aççiq şuvoq (Artemisia absinthium L.) quruq ekstrakti tutgan "Artabsin" gidrogeli misolida, çop etilgan eksperimental ma'lumotlar asosida körib çiqilgan. Ekstraktning polifenol tarkibi, antimikrob faolligi va xavfsizligi, şuningdek ösimlik ekstraktlari tutgan karbomerli gellarning fizik-kimyoviy körsatkiçlari tahlil qilindi. Diabetik oyoq infeksiyalarida eng köp ajratiladigan Staphylococcus aureus uçun ekstraktning minimal ingibirlovçi konsentratsiyasi 0,31-0,625 mg/ml bölgani hisobga olinib, gelda uning uluşi 5 % deb belgilandi. 1,0 % karbomer, 10 % propilenglikol va 5 % glitserin tutgan, pH 5,5–6,0 gaça neytrallangan asos, töqqiz bosqiçli texnologik sxema va steril gel uçun sifat me'yorlari loyihasi taklif etildi.*

Kalit sözlar: *diabetik oyoq yarasi, aççiq şuvoq, quruq ekstrakt, "Artabsin" gidrogeli, karbomer, texnologik sxema, sterillik, standartlaş.*

INTRODUCTION

According to the International Diabetes Federation, in 2025, 589 million people aged 20–79 years worldwide were living with diabetes [1]. The global prevalence of foot ulcers among patients with diabetes is 6.3% (95% CI 5.4–7.3%) [2], and healed ulcers frequently recur [3]. When an ulcer becomes infected, treatment becomes more complicated: the international IWGDF/IDSA guideline addresses the diagnosis of diabetic foot infection, the choice of antimicrobial therapy and the reduction of the number of amputations [4]. A meta-analysis pooling data from 112 studies (16,159 patients) found that the pathogen most frequently isolated from these infections was *Staphylococcus aureus*, of which 18.0% were methicillin-resistant strains [5].

Wound dressings and topical dosage forms play a central role in local treatment. In a Cochrane systematic review, pooling three randomised trials showed that hydrogel dressings healed more diabetic foot ulcers than basic contact dressings (risk ratio 1.80; 95% CI 1.27–2.56); however, this conclusion was interpreted with caution because the trials were small and their risk of bias was unclear [6]. Amid growing antibiotic resistance, interest in plant substances with antimicrobial and anti-inflammatory activity is also increasing [7].

The aerial parts of wormwood (*Artemisia absinthium* L., family Asteraceae) contain essential oil, bitter sesquiterpene lactones, flavonoids, phenolic acids,

tannins and lignans; in traditional medicine the plant has been used to treat poorly healing wounds [8]. Its antimicrobial, antioxidant, anti-inflammatory and analgesic activities have been demonstrated in experimental studies [7], and it has long been used in Central Asian folk medicine as well [9]. Resolution No. PP-4670 of the President of the Republic of Uzbekistan dated 10 April 2020 sets the task of creating added value through the deep processing of 750 species of medicinal plants of the local flora [10].

Wormwood extract has been studied in several topical dosage forms. In a randomised double-blind trial in 90 patients with knee osteoarthritis, a 3% ointment produced an effect close to that of piroxicam gel [11]. In a rat wound model, a 10% ointment accelerated wound contraction to the level of the reference drug [12]. A 20% aqueous extract has been used in a cosmetic cream [13]. In a bilayer dressing developed for chronic wounds, wormwood extract was used together with cinnamaldehyde and an oxygen source; the dressing inhibited the growth of Gram-positive and Gram-negative microorganisms and provided histologically satisfactory healing [14]. Hydrogel bases are superior to ointments and creams in ease of application, cooling effect and biocompatibility [15]; extract components were released to a high degree from carbomer-based herbal gels [16; 17]. However, no publications were found on the composition and technology of a hydrogel containing dry wormwood extract intended for diabetic foot ulcers.

Aim of the study: to develop the composition and technology of a hydrogel based on dry extract. The object of the study was “Artabsin”, a hydrogel containing dry wormwood extract intended for the topical treatment of diabetic foot ulcers; its composition, manufacturing technology and quality specifications were substantiated on the basis of published experimental data.

MATERIALS AND METHODS

The study was carried out in two stages. In the first stage, publications on *Artemisia absinthium* extracts, diabetic foot ulcers and carbomer-based herbal gels were analysed. The search was performed in PubMed, Crossref and Semantic Scholar using the keywords “*Artemisia absinthium*”, “extract”, “gel”, “ointment”, “wound healing”, “diabetic foot ulcer”, “carbomer”, “spreadability”, “in vitro release” and their combinations, with the main focus on work from the last ten years. The analysis included studies reporting quantitative data on the phytochemical composition, antimicrobial activity, cytotoxicity or acute toxicity of the extract, as well as studies giving the pH, viscosity, spreadability and release parameters of carbomer-based herbal gels. The bibliographic details of the articles were verified by DOI, and regulatory documents against official sources.

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In the second stage, the gel composition was designed on the basis of the collected data. The following were selected: a hydroalcoholic dry extract of wormwood herb (Absinthii herba) as the active substance, carbomer 940 as the gelling agent, propylene glycol and glycerol as polyhydric alcohols, triethanolamine (TEA) as the neutralising agent, and methyl and propyl parahydroxybenzoates as preservatives. The amount of extract was chosen on the basis of minimum inhibitory concentration (MIC) values and the concentrations used in previously tested dosage forms, and the amounts of excipients on the basis of the results for analogous gels. The quality requirements were set according to the European Pharmacopoeia monograph on semi-solid preparations for cutaneous application [18].

The following test methods were planned for the finished gel: appearance and homogeneity (visual), pH (potentiometric), viscosity (rotational viscometer, 25 °C), spreadability (spreading diameter between two glass plates under a defined load), colloidal stability (centrifugation) and thermal stability (storage at 40 °C and 4–6 °C). The in vitro release of the active substances will be studied in a Franz diffusion cell at 32 °C, and the results will be analysed using zero-order, first-order, Higuchi and Korsmeyer–Peppas models [19; 20]. The content of total phenolic compounds (Folin–Ciocalteu method) and chlorogenic acid (high-performance liquid chromatography, HPLC) was selected for standardisation.

RESULTS

Phytochemical and pharmacological profile of the extract. According to the studies analysed, wormwood extracts are rich in polyphenols (Table 1). Eleven polyphenols were identified in a methanolic dry extract, the most abundant being chlorogenic acid at 3.75 g/100 g [12]. Mass spectrometric analysis identified 90 compounds in a methanolic extract, 69 of which were described for this species for the first time; the main groups were quinic acid derivatives and flavonoids [21]. The yield of an aqueous extract was 19.32%, with total polyphenols of 58.66 ± 2.16 µg GAE/mg and flavonoids of 6.85 µg QE/mg [22].

Table 1.

Parameters of wormwood extracts relevant to substantiating the gel composition

Parameter	Value	Extract type	Source
Chlorogenic acid content	3.75 g/100 g dry extract	methanolic	[12]
Total polyphenols	58.66 ± 2.16 µg GAE/mg	aqueous	[22]
Antiradical activity (DPPH), IC50	45.48 ± 0.37 µg/mL	aqueous	[22]
MIC, *S. aureus* ATCC 6538	0.31–0.625 mg/mL	methanolic	[12]
MIC, *E. coli* ATCC 10536	1.25–2.5 mg/mL	methanolic	[12]

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MIC: *Candida* species / bacteria	0.5–1 / 0.25–4 mg/mL	ethanolic	[23]
Cytotoxicity to HaCaT and HGF-1 cells	not observed up to 400 µg/mL	ethanolic	[23]
Acute oral toxicity (mice)	no deaths at 5000 mg/kg	methanolic	[21]
Acute dermal and oral toxicity	not detected	methanolic	[12]

The safety profile is also favourable for cutaneous use: no cytotoxicity towards keratinocytes (HaCaT) and gingival fibroblasts (HGF-1) was observed up to 400 µg/mL [23], no deaths were recorded in mice at a dose of 5000 mg/kg [21], and no acute dermal or oral toxicity was found in animals [12]. The extract acted on *S. aureus* at a concentration approximately 4 times lower than on *E. coli* (MIC 0.31–0.625 and 1.25–2.5 mg/mL, respectively). Since *S. aureus* is the pathogen most frequently isolated from diabetic foot infections [5], this property is consistent with the intended indication of "Artabsin" hydrogel.

Selection of the extract concentration. In the topical dosage forms tested, the extract content ranged from 3% to 20% (Figure 1). The 3% ointment improved pain and functional scores (except joint stiffness) to a degree close to that of piroxicam gel, whereas the liniment at the same concentration reduced pain only at week 4, and the symptoms returned by week 6 [11]. In the rat wound model, a statistically significant effect was produced by the 10% ointment [12].

Figure 1. Extract content in topical dosage forms containing wormwood extract and in the proposed gel compositions, % (based on [11; 12; 13])

The extract content in the main composition of "Artabsin" hydrogel was set at 5% (50 mg/g). This amount exceeds the upper limit of the MIC for *S. aureus* (0.625 mg/mL) by approximately 80 times. Given that only the 10% ointment gave a significant result in the wound model [12], an alternative composition containing 10% extract (G4) was also designed; comparing the two concentrations is a task for further experiments.

Selection of the gel base. Data on carbomer gels containing plant extracts are given in Table 2. As the carbomer content increased, the viscosity and adhesiveness of the gel increased, while its spreadability decreased [24]. Gels containing 1.0% carbomer and 10% propylene glycol remained stable for 12 months [17].

Table 2.

Physicochemical parameters of carbomer gels containing plant extracts (literature data)

Extract (gel)	Gelling agent	pH	Viscosity, mPa·s	Spreadability	In vitro release	Source
Erythrina subumbrans	Carbopol 940 0.5% + HPMC 1.5%	5.62	12 670	6.2 cm	—	[24]

Centella asiatica + *Moringa oleifera*	Carbopol 940 0.6% + TEA 0.4%	7.1 ± 0.29	20 080	5.7 ± 0.21 cm	—	[15]
Cuscuta reflexa	Carbopol 934	6.32	14 872	76%	64.00% (14 h)	[25]
Limonium gmelinii	Carbomer 1.0% + propylene glycol 10%	—	acceptable, thixotropic	—	87.36% and 85.78%	[17]
Cardiospermum halicacabum + *Vitex negundo*	Carbopol 934, 1.5%	—	—	—	98.4% (F4)	[16]

The pH of the analogous gels ranged from 5.62 to 7.1 [15; 24; 25]. The pH of the intact skin surface is on average below 5 [26], whereas in the wound environment different pH ranges have been shown to favour different stages of healing [27]. Therefore, pH 5.0–6.0 was chosen as the target range for the gel, and its effect on wound healing will be examined separately. Target ranges of 10 000–20 000 mPa·s for viscosity and 5–7 cm for spreadability were set on the basis of the results for analogous gels. From the analogous gels, 64–98.4% of the active substances were released (Figure 2), and release followed the Higuchi model [20].

Figure 2. In vitro release of active substances from carbomer gels containing plant extracts, % (based on [16; 17; 25])

Model compositions and main formulation. On the basis of these data, four model compositions differing in carbomer and extract content were designed (Table 3).

Table 3.

Model compositions of "Artabsin" hydrogel (per 100.0 g, g)

Component	Function	G1	G2	G3	G4
Dry wormwood extract	active substance	5.0	5.0	5.0	10.0
Carbomer 940	gelling agent	0.5	1.0	1.5	1.0
Propylene glycol	co-solvent	10.0	10.0	10.0	10.0
Glycerol	humectant, plasticiser	5.0	5.0	5.0	5.0
Methyl parahydroxybenzoate	preservative	0.15	0.15	0.15	0.15
Propyl parahydroxybenzoate	preservative	0.05	0.05	0.05	0.05
Triethanolamine	neutralising agent	to pH 5.5–6.0	to pH 5.5–6.0	to pH 5.5–6.0	to pH 5.5–6.0
Purified water	dispersion medium	to 100.0	to 100.0	to 100.0	to 100.0

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Based on the trend shown in Table 2, insufficient viscosity is expected for G1 and reduced spreadability for G3 [24]. Therefore, G2 was selected as the main formulation, while G4 is intended to test gel stability at a high extract load. The propylene glycol content (10%) was adopted from the analogous composition that showed the highest extract release [17]; it also serves as a solvent for the parabens.

Process flow chart. The process flow chart for the manufacture of "Artabsin" hydrogel is shown in Figure 3. The extract is incorporated into the carbomer dispersion before neutralisation, so the amount of TEA is titrated to the target pH taking into account the organic acids present in the extract. Because the gel is applied to open wounds, it must be sterile: according to the European Pharmacopoeia, semi-solid preparations intended for use on severely injured skin are sterile and are prepared using methods that ensure sterility [18]. The sterilisation method (aseptic manufacture or terminal sterilisation) and its effect on the gel rheology and the extract composition will be selected experimentally.

1. Incoming control of raw materials and excipients (moisture, total phenols and chlorogenic acid in the extract)
2. Dissolution of the parabens in propylene glycol at 50–60 °C
3. Sprinkling carbomer 940 onto 70% of the purified water under stirring (400–600 rpm), swelling for 12–24 h
4. Dissolution of the dry extract in a mixture of the remaining water and glycerol at 40–45 °C, passing through a 0.2 mm sieve
5. Gradual addition of the extract and preservative solutions to the carbomer dispersion, stirring for 15 min
6. Neutralisation with TEA to pH 5.5–6.0 (gel formation)
7. Homogenisation and deaeration under vacuum (15–20 min)
8. Sterilisation or filling under aseptic conditions into 30.0 g tubes, labelling
9. Quality control of the finished product (Table 4)

Figure 3. Process flow chart for the manufacture of "Artabsin" hydrogel

Quality specifications. The proposed quality parameters for "Artabsin" hydrogel are given in Table 4. According to the pharmacopoeial requirement, if a preservative is added, its necessity and efficacy must be demonstrated during development [18]. Stability studies were planned in accordance with the ICH Q1A(R2) guideline [28].

Table 4. Quality specifications for "Artabsin" hydrogel (draft)

Parameter	Specification	Method

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Appearance	homogeneous, semi-transparent gel with the colour and odour characteristic of the extract	visual, organoleptic
pH	5.0–6.0	potentiometric
Viscosity (25 °C)	10 000–20 000 mPa·s	rotational viscometry
Spreadability	5–7 cm	parallel-plate method
Colloidal and thermal stability	no phase separation	centrifugation (3000 rpm, 15 min); 7 days at 40 °C and 4–6 °C
Total phenols (calculated as chlorogenic acid); chlorogenic acid	90–110% of the declared content; identification	spectrophotometry (Folin–Ciocalteu); HPLC
In vitro release	release profile and kinetic model to be determined	Franz cell, 32 °C
Thujone content	controlled	gas chromatography–mass spectrometry
Sterility	sterile	pharmacopoeial sterility test [18]
Preservative efficacy	to be demonstrated	pharmacopoeial method [18]

DISCUSSION

The results of the analysis indicate that dry wormwood extract can be used in hydrogel form, but the strength of each piece of evidence differs. The effect of the extract on *S. aureus* is based on in vitro data [12], and its wound-healing effect was obtained in non-diabetic rats [12]. Because in the dressing designed for chronic wounds the extract was used together with cinnamaldehyde and an oxygen source [14], the effect observed there cannot be attributed to wormwood alone. Therefore, the efficacy of "Artabsin" hydrogel needs to be demonstrated on wounds in an experimental diabetes model.

The choice of a hydrogel form is supported by clinical data: hydrogel dressings healed more diabetic foot ulcers than basic contact dressings, but the quality of the evidence was rated as low and hydrogels were not compared with other modern dressings [6]. The difference in effect between an ointment and a liniment of the same concentration in the osteoarthritis trial [11] shows that the choice of dosage form influences the outcome. The bioadhesive properties of carbomer hydrogels [20] help the gel to remain on the wound surface. The gel does not replace antibiotic therapy: infected diabetic wounds are treated according to the guideline [4], and "Artabsin" is regarded as a topical adjunct.

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Technologically, the most important change relates to the sterility requirement [18]. To obtain a sterile gel, either terminal sterilisation or aseptic manufacture is chosen; in both cases, the viscosity of the carbomer gel and the polyphenol content of the extract must be compared before and after sterilisation. The release of 64–98.4% from analogous carbomer gels [16; 17; 25] suggests adequate polyphenol release from the G2 composition as well; however, release depends on carbomer concentration and viscosity [24], so compositions G2 and G3 will be compared experimentally.

Standardisation of the extract takes into account that the chemical composition of wormwood depends on the place of growth and the phenological stage [29]. It is proposed to standardise the dry extract and the gel by total phenolic compounds and by chlorogenic acid as a marker compound; this choice is justified by chlorogenic acid being the most abundant polyphenol in the dry extract [12]. α-Thujone has been detected in the essential oil and included among its active compounds [9], while prolonged use of the essential oil may cause toxic and mental disorders [7]; therefore, control of the thujone content was included in the quality specifications.

Limitation of the study: the numerical values used to substantiate the composition were obtained by different authors with different extracts (methanolic, ethanolic, aqueous) and under different conditions. The proposed draft specifications must be confirmed experimentally on samples prepared with a hydroalcoholic dry extract obtained from local raw material. The developed composition is consistent with the tasks of processing local medicinal raw materials set out in Resolution No. PP-4670 [10].

CONCLUSIONS

1. Published data show that wormwood extract is rich in polyphenols (chlorogenic acid up to 3.75 g/100 g), is active against *S. aureus*, the pathogen most frequently isolated from diabetic foot infections (MIC 0.31–0.625 mg/mL), and has low toxicity; this provides grounds for using it as the active substance in a hydrogel.

2. An aqueous base containing 5% dry extract, 1.0% carbomer 940, 10% propylene glycol, 5% glycerol and parabens, neutralised with TEA to pH 5.5–6.0 (G2), was proposed as the main formulation of “Artabsin” hydrogel. A nine-stage process flow was developed that provides for incorporation of the extract before neutralisation and release of the product in sterile form.

3. Draft quality specifications for the gel were drawn up, including pH 5.0–6.0, viscosity 10 000–20 000 mPa·s, spreadability 5–7 cm, standardisation by polyphenols, sterility and preservative efficacy. At the next stage, these specifications will be tested experimentally and the efficacy of the gel will be evaluated in an experimental diabetic wound model.

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PRUNUS TURKUMIGA MANSUB AYRIM O‘SIMLIKLARNING BIOLOGIK FAOL BIRIKMALARI VA ULARDAN SHIFOBAXSH MAHSULOTLAR OLISH ISTIQBOLLARI

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Annotatsiya. *Mazkur tezisda ranodoshlar oilasiga mansub Prunus turkumining Prunus cerasifera var. Pissardii L, Prunus cerasifera L. va Prunus cerasus L. turlarining biologik faol birikmalari, kimyoviy tarkibi hamda ulardan shifobaxsh mahsulotlar olish istiqbollari ilmiy adabiyotlar asosida tahlil qilinadi. Fenol kislotalar, flavonoidlar, antosianlar va boshqa polifenollarning ahamiyati yoritilib, o‘simlik xomashyosini fitokimyoviy o‘rganish, ekstraksiya qilish va kimyoviy tarkibiga ko‘ra tasniflash yo‘nalishlari bayon etiladi.*

Kalit so‘zlar: *Prunus cerasifera L, Prunus cerasifera var. Pissardii L, Prunus cerasus L, biologik faol birikmalar, fitokimyoviy tarkib, flavonoidlar, fenol kislotalar, antosianlar, antioksidant faollik.*

Аннотация. *В тезисе на основе научной литературы анализируются биологически активные соединения растений рода Prunus, в частности Prunus cerasifera var. Pissardii, Prunus cerasifera L. и Prunus cerasus L., их химический состав и перспективы получения лечебно-профилактической продукции. Рассматриваются фенольные кислоты, флавоноиды, антоцианы и другие полифенолы, а также подходы к фитохимическому исследованию, экстракции и классификации растительного сырья.*

Ключевые слова: *Prunus cerasifera L., Prunus cerasifera var. Pissardii, Prunus cerasus L., биологически активные соединения, фитохимический состав, флавоноиды, фенольные кислоты, антоцианы, антиоксидантная активность.*

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Abstract. *This thesis reviews the biologically active compounds of selected species of the genus Prunus, namely Prunus cerasifera var. Pissardii, Prunus cerasifera L., and Prunus cerasus L., with particular attention to their chemical composition and potential use in the development of health-related products. Based on published research, phenolic acids, flavonoids, anthocyanins, and other polyphenols are discussed, alongside approaches to phytochemical investigation, extraction, and classification of plant raw materials.*

Keywords: *Cherry plum (Prunus cerasifera L.), purple leaf plum (Prunus cerasifera var. Pissardii), sour cherry (Prunus cerasus L.), biologically active compounds, phytochemical composition, flavonoids, phenolic acids, anthocyanins, antioxidant activity.*

KIRISH

Tabiiy o‘simlik xomashyosi asosida biologik faol mahsulotlar olish, ularning kimyoviy tarkibini aniqlash va sifat ko‘rsatkichlarini baholash zamonaviy kimyo, farmatsiya hamda tovarlar kimyosining dolzarb yo‘nalishlaridan biridir. Bugungi kunda sintetik dori vositalari va oziq-ovqat qo‘shimchalari o‘rnini bosuvchi xavfsiz, ekologik toza tabiiy manbalarni izlab topish jahon miqyosida ustuvor vazifa hisoblanadi.

O‘simliklarda uchraydigan ikkilamchi metabolitlar, xususan, polifenollar, flavonoidlar, fenol kislotalar va antosianlar yuqori biologik faolligi bilan ilmiy qiziqish uyg‘otadi. Ularning ayrimlari kuchli antioksidant, yallig‘lanishga qarshi va kapillyarlarni mustahkamlovchi xususiyat namoyon qilishi mumkin.

Ra’nodoshlar oilasiga mansub *Prunus* turkumi mevali va manzarali o‘simliklarni o‘z ichiga oladi hamda O‘zbekiston hududida keng tarqalgan va yetarli xomashyo bazasiga ega. Mazkur turkum vakillarining mevalari bilan bir qatorda, ko‘pincha ikkilamchi mahsulot sifatida qolib ketadigan barglari va boshqa vegetativ qismlari ham fenol birikmalarning istiqbolli manbai sifatida o‘rganilmoqda. Bu esa o‘simlik xomashyosidan kompleks va chiqindisiz foydalanish imkonini beradi. Shu sababli *Prunus cerasifera* var. *Pissardii* (qizil bargli olxo‘ri), *Prunus cerasifera* L. (tog‘olcha) va *Prunus cerasus* L. (oddiy olcha) turlarini qiyosiy fitokimyoviy tadqiq etish ularning xomashyo sifatidagi imkoniyatlarini baholash, shuningdek, tovarlar kimyosi nuqtayi nazaridan ularni identifikatsiya qilish va sifat mezonlarini ishlab chiqish uchun muhimdir.

ASOSIY QISM

Prunus cerasifera L. barglari tarkibidagi fenol birikmalarni o‘rganishga bag‘ishlangan tadqiqotda xromatografik ajratish va spektroskopik tahlil yordamida 11 ta fenol kislota identifikatsiya qilingan. Ular qatoriga p-kumar, kofein, ferul,

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xlorogen, gall va protokatex kislotalari hamda xin kislotasining ayrim hosilalari kiradi [1]. Bu natijalar *P. cerasifera* barglarini fenol birikmalar manbai sifatida chuqurroq o‘rganish zarurligini ko‘rsatadi.

Prunus cerasifera turining binafsha bargli shakllari, jumladan, *Pissardii* nomi bilan tanilgan manzarali shakllar antosian pigmentlari va boshqa polifenollar nuqtayi nazaridan alohida qiziqish uyg‘otadi. *Prunus* mevalarining turli namunalari qiyoslangan tadqiqotda binafsha bargli olcha-olxo‘ri shakli ham tekshirilgan; ishda tur va namunalar o‘rtasida fenol profili hamda biologik faollik ko‘rsatkichlari farqlanishi qayd etilgan [2]. Shuning uchun *Pissardii* shaklining kimyoviy tarkibini alohida namuna sifatida tahlil qilish maqsadga muvofiq.

Prunus cerasus L. barglari ham biologik faol polifenollar manbai sifatida o‘rganilgan. 2024-yilda chop etilgan tadqiqotda olcha barglari tarkibida xlorogen kislota, flavonollar va proantosianidinlar aniqlangan hamda navlar kesimida ularning miqdoriy ko‘rsatkichlari sezilarli farq qilishi ko‘rsatilgan. Mualliflar ayrim namunalar ekstraktlarida in vitro antioksidant faollik yuqori bo‘lganini qayd etgan [3]. Bu holat o‘simlik turi bilan bir qatorda nav, genotip va o‘sish sharoitlarini ham hisobga olish zarurligini anglatadi.

Uchala obyektni o‘zaro taqqoslashda quyidagi birikmalar guruhlariga e’tibor qaratish mumkin: flavonoidlar (rutin, kversetin va kempferol hosilalari), fenol kislotalar (xlorogen, kofein, ferul va gall kislotalari), antosianlar hamda taninlar. Biroq ushbu moddalarning barchasi har bir tanlangan turda mavjud deb oldindan xulosa chiqarish to‘g‘ri emas. Ularning sifat va miqdoriy tarkibi tegishli laboratoriya tahlillari orqali tasdiqlanishi lozim.

Biologik faol moddalarni ajratib olishda suvli va suv-spirtli erituvchilar bilan ekstraksiya qilish usullaridan foydalanish mumkin. Jarayon samaradorligiga erituvchi tarkibi, xomashyo va erituvchi nisbati, harorat, ekstraksiya davomiyligi hamda maydalash darajasi ta’sir ko‘rsatadi. Ultratovush yordamida ekstraksiya qilish ayrim sharoitlarda ajratib olish jarayonini jadallashtirish imkonini beradi. Shu bilan birga, ekstraksiya sharoitlarini har bir xomashyo turi uchun tajriba asosida tanlash zarur.

Kimyoviy tarkibni aniqlash uchun yuqori samarali suyuqlik xromatografiyasi (HPLC-PDA/UV), umumiy fenol va flavonoidlar miqdorini baholash uchun spektrofotometrik usullar, antioksidant faollikni o‘rganish uchun DPPH va FRAP testlaridan foydalanish mumkin. Mineral elementlar tarkibini aniqlashda ICP-OES yoki ICP-MS usullari qo‘llanadi. Olingan natijalar asosida xomashyoni ustun biologik faol birikmalar guruhiga, sifat ko‘rsatkichlariga va amaliy qo‘llash istiqboliga ko‘ra tasniflash mumkin.

Shuningdek, Prunus turkumining ayrim vakillarida sianogen glikozidlar uchrashi mumkinligi sababli xomashyo va undan olinadigan mahsulotlar xavfsizligini baholash alohida ahamiyatga ega. Shifobaxsh mahsulot ishlab chiqish masalasi faqat biologik faollik bilan cheklanmaydi; toksikologik xavfsizlik, standartlashtirish, saqlash barqarorligi va sifat nazorati ham ilmiy asoslanishi kerak.

XULOSA

Ilmiy adabiyotlar tahlili *Prunus* turkumiga mansub ayrim o‘simliklarda fenol kislotalar, flavonoidlar, antosianlar va boshqa polifenol birikmalar uchrashini ko‘rsatadi. *P. cerasifera L* barglarida bir qator fenol kislotalar aniqlangani, *P. cerasus L* barglarida esa xlorogen kislota, flavonollar va proantosianidinlar miqdori o‘rganilgani mazkur xomashyolarni fitokimyoviy tadqiq etish uchun asos bo‘la oladi.

Prunus cerasifera var. *Pissardii*, *Prunus cerasifera L. va Prunus cerasus L.* turlarini bir xil metodik yondashuv asosida qiyosiy o‘rganish ularning umumiy va farqli kimyoviy belgilarini aniqlash imkonini beradi. Keyingi bosqichlarda biologik faol birikmalarni ajratish, miqdoriy tahlil qilish, antioksidant faollikni baholash va xavfsizlik ko‘rsatkichlarini tekshirish orqali ushbu o‘simliklar asosida standartlashtirilgan biologik faol mahsulotlar olish istiqbollarini ilmiy jihatdan asoslash mumkin.

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ANOR PO‘STLOG‘IDAGI BIOLOGIK FAOL MODDALARNING BIOTEXNOLOGIYADAGI AHAMIYATI

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Annotatsiya. *Maqolada anor (Punica granatum L.) po‘stlog‘ida to‘planadigan biologik faol moddalarning biotexnologik jarayonlardagi o‘rni tahlil qilingan. Po‘stloq ellagitanninlar, ellag kislotasi, flavonoidlar va pektinga boy bo‘lib, mikrobiologik fermentatsiya, ferment yordamida ekstraksiya, yashil sintez usulida nanozarrachalar olish, biopolimer plyonkalar yaratish va bioenergetika sohalarida qimmatli substrat hisoblanadi. Adabiyotlar tahlili asosida po‘stloqni biotexnologik qayta ishlashning asosiy yo‘nalishlari, afzalliklari va hal etilmagan muammolari yoritilgan.*

Kalit so‘zlar: *anor po‘stlog‘i, biotexnologiya, fermentatsiya, tannaza, ellag kislotasi, urolitinlar, nanozarrachalar, biopolimerlar.*

Аннотация. *В статье анализируется роль биологически активных веществ кожуры граната (Punica granatum L.) в биотехнологических процессах. Кожура богата эллагитаннинами, эллаговой кислотой, флавоноидами и пектином и служит ценным субстратом для микробной ферментации, ферментативной экстракции, «зелёного» синтеза наночастиц, получения биополимерных плёнок и в биоэнергетике. На основе анализа литературы описаны основные направления биотехнологической переработки кожуры, её преимущества и нерешённые проблемы.*

Ключевые слова: *кожура граната, биотехнология, ферментация, танназа, эллаговая кислота, уролитины, наночастицы, биополимеры.*

Abstract. *The article analyzes the role of bioactive compounds of pomegranate (Punica granatum L.) peel in biotechnological processes. The peel is rich in ellagitannins, ellagic acid, flavonoids and pectin and is a valuable substrate for microbial fermentation, enzyme-assisted extraction, green synthesis of nanoparticles, biopolymer films and bioenergy production. Based on a literature review, the main directions of biotechnological valorization of the peel, its advantages and unresolved problems are described.*

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Keywords: *pomegranate peel, biotechnology, fermentation, tannase, ellagic acid, urolithins, nanoparticles, biopolymers.*

Kirish. Biotexnologiya tirik organizmlar, ularning hujayralari va fermentlaridan foydalanib, inson uchun zarur mahsulotlar olish hamda xomashyoni qayta ishlash usullarini o‘rganuvchi fan sohasidir [1; 2]. Zamonaviy biotexnologiyaning muhim yo‘nalishlaridan biri agrosanoat qoldiqlarini qimmatli mahsulotlarga aylantirishdir. Bu yondashuv chiqindilar hajmini kamaytiradi va arzon xomashyo manbalarini jalb etish imkonini beradi.

Anor sharbati va konsentratlari ishlab chiqarishda po‘stloq mevaning taxminan 30–50 foizini tashkil etadigan asosiy qoldiqqa aylanadi [4]. Po‘stloq tarkibida ellagitanninlar (punikalagin, punikalin), ellag va galla kislotalari, flavonoidlar, antosiyaninlar, pektin va ozuqa tolalari mavjud [4; 5]. Bunday boy tarkib po‘stloqni biotexnologik jarayonlar uchun ham substrat, ham biofaol birikmalar manbai sifatida jozibador qiladi. Ayniqsa, O‘zbekistonda anor yetishtirish hajmining ortib borishi bu qoldiqlardan foydalanish masalasini dolzarb qilib qo‘ymoqda.

Tadqiqotning maqsadi — anor po‘stlog‘idagi biologik faol moddalarning biotexnologiyadagi ahamiyatini ilmiy manbalar asosida baholash va ularni qo‘llashning asosiy yo‘nalishlarini tizimlashtirishdir.

Asosiy qism. Tadqiqotda ilmiy adabiyotlarni tahlil qilish, tizimlashtirish va solishtirish usullaridan foydalanildi. Anor po‘stlog‘ining biotexnologik ahamiyati quyidagi yo‘nalishlar bo‘yicha ko‘rib chiqildi.

1. Biofaol moddalarning biotexnologik xususiyatlari. Po‘stloqdagi asosiy biofaol modda punikalagin bo‘lib, u gidrolizlanuvchi ellagitannin hisoblanadi. U fermentlar yoki kislotalar ta’sirida gidrolizlanib, ellag kislotasi va glyukoza hosil qiladi. Ellag kislotasi esa inson ichak mikrobiotasi ta’sirida urolitinlarga aylanadi; bu birikmalar yuqori biologik faolligi bilan ajralib turadi [4]. Demak, po‘stloq fenollarining biologik qiymati ko‘p jihatdan mikroorganizmlar va fermentlar faoliyatiga bog‘liq, bu esa uni biotexnologiya nuqtayi nazaridan qiziqarli ob’yektga aylantiradi.

2. Ferment yordamida ekstraksiya. An’anaviy erituvchi ekstraksiyasi organik erituvchilarni ko‘p talab qiladi va yuqori haroratda fenollarning parchalanishiga olib kelishi mumkin. Ferment yordamida ekstraksiyada pektinaza, sellyulaza va gemisellyulaza kabi fermentlar o‘simlik hujayra devorlarini yumshoq sharoitda parchalaydi va hujayra ichidagi fenollarning ajralib chiqishini osonlashtiradi. Shu tufayli ekstraksiya past haroratda va suv muhitida o‘tkaziladi, mahsulot sifati yaxshilanadi, jarayon esa ekologik jihatdan xavfsizroq bo‘ladi. Bu usul ultratovush va mikroto‘lqinli ekstraksiya bilan birgalikda ham qo‘llanilmoqda [4].

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3. Mikrobiologik fermentatsiya va fermentlar ishlab chiqarish. Po‘stloq tarkibida uglevodlar, pektin va tanninlar bo‘lgani uchun u qattiq fazali fermentatsiyada (solid-state fermentation) arzon substrat vazifasini o‘tashi mumkin. Adabiyotlarda *Aspergillus* va *Penicillium* avlodiga mansub mikromitsetlarning tanninlarga boy agrosanoat qoldiqlarida o‘sib, tannaza fermentini sintez qilishi bayon etilgan. Tannaza tanninlarni gidrolizlab, galla va ellag kislotalarini hosil qiladi; ferment oziq-ovqat, choy, ichimliklar va farmatsevtika sanoatida qo‘llaniladi [1]. Shuningdek, po‘stloqdan pektinaza, sellyulaza va organik kislotalar (limon kislotasi) olish uchun substrat sifatida foydalanish imkoniyatlari o‘rganilmoqda. Substrat arzon va qoldiq bo‘lgani uchun ferment tannarxi pasayadi.

Fermentatsiya jarayonining o‘zi ham po‘stloqning biofaolligini o‘zgartiradi: mikroorganizmlar bog‘langan fenollarni erkin shaklga o‘tkazishi, ularning biologik o‘zlashtirilishini oshirishi mumkin. Shu sababli fermentatsiyalangan po‘stloq kukunlari funksional oziq-ovqat qo‘shimchalari va em-xashak qo‘shimchalari sifatida istiqbolli hisoblanadi, biroq har bir shtamm va sharoit uchun faollik hamda xavfsizlik alohida baholanishi kerak.

4. Probiotiklar va prebiotiklar bilan bog‘liqlik. Po‘stloqdagi pektin va ozuqa tolalari prebiotik xususiyatga ega bo‘lishi mumkin: ular foydali ichak bakteriyalarining o‘sishini rag‘batlantiradi. Polifenollar esa patogen mikroorganizmlarga susaytiruvchi, foydali bakteriyalarga esa nisbatan kuchsiz ta’sir ko‘rsatishi haqida ma’lumotlar mavjud [4; 5]. Bu xususiyatlar po‘stloq ekstraktlarini probiotik shtammlar bilan sinbiotik mahsulotlarda sinovdan o‘tkazish uchun asos yaratadi.

5. Nanozarrachalarning yashil sintezi. Biotexnologiyaning zamonaviy yo‘nalishlaridan biri — metall nanozarrachalarni biologik vositalar yordamida olishdir. Anor po‘stlog‘i ekstrakti tarkibidagi fenol birikmalari metall ionlarini qaytaruvchi hamda hosil bo‘lgan zarrachalarni barqarorlashtiruvchi vosita vazifasini bajaradi. Shu tariqa kumush, oltin, rux oksidi va boshqa nanozarrachalarni toksik reagentlarsiz sintez qilish mumkin. Olingan zarrachalar antimikrob qoplamalar, sensorlar, qadoqlash materiallari va suvni tozalash tizimlarida qo‘llanishga tavsiya etiladi. Biroq nanozarrachalarning inson va atrof-muhitga ta’siri hali to‘liq o‘rganilmagan, shuning uchun toksikologik tekshiruvlar zarur.

6. Biopolimerlar va biologik parchalanuvchi qadoqlash. Po‘stloqdan ajratib olingan pektin va tolalar xitozan, kraxmal, jelatin kabi biopolimerlar bilan birga yeyiladigan va biologik parchalanadigan plyonkalar tayyorlash uchun ishlatiladi. Ekstrakt qo‘shilishi plyonkaga antioksidant va antimikrob xossa beradi, natijada oziq-ovqat mahsulotlarining saqlanish muddati uzayadi. Bu yo‘nalish sintetik plastik

qadoqlarni almashtirish va ularning ekologik zararini kamaytirish nuqtayi nazaridan alohida e’tiborga loyiq [4].

7. Bioenergetika va biosorbsiya. Po‘stloqni anaerob hazm qilish orqali biogaz, fermentatsiya orqali bioetanol olish mumkin. Biroq tanninlar metan hosil qiluvchi mikroorganizmlarni susaytirishi mumkinligi sababli oldindan ishlov berish yoki boshqa organik qoldiqlar bilan aralashtirish tavsiya etiladi. Shuningdek, po‘stloq biomassasi suvdan og‘ir metallar va bo‘yoq moddalarini yutuvchi biosorbent sifatida o‘rganilmoqda: uning yuzasidagi karboksil va gidroksil guruhlari metall ionlarini bog‘laydi. Bu sanoat oqava suvlarini arzon usulda tozalash imkonini beradi.

8. Tibbiy biotexnologiya. Po‘stloq ekstraktlarining antioksidant, antimikrob va yallig‘lanishga qarshi faolligi [5; 6; 7] ularni dori vositalari, kosmetik kompozitsiyalar va biologik faol qo‘shimchalar yaratishda xomashyo sifatida ko‘rib chiqish imkonini beradi. Hujayra madaniyatlari va laboratoriya hayvonlarida olingan natijalar istiqbolli, biroq klinik tasdiq uchun qo‘shimcha tadqiqotlar zarur.

9. Muammolar va istiqbollar. Po‘stloqni biotexnologik qayta ishlashda bir qator muammolar saqlanib qolmoqda: xomashyoning mavsumiyligi va tez buzilishi, kimyoviy tarkibning nav va sharoitga qarab o‘zgarishi, jarayonlarni sanoat miqyosiga o‘tkazishdagi qiyinchiliklar, tanninlarning ayrim mikroorganizmlarga ingibitor ta’siri hamda pestitsid qoldiqlari xavfi. Ularni hal etish uchun xomashyoni dastlabki barqarorlashtirish (quritish, muzlatish), mahalliy navlar bo‘yicha tarkibiy xaritalar tuzish, mikroorganizm shtammlarini tanlash va jarayon parametrlarini optimallashtirish kerak. Ilmiy muassasalar, oliy ta’lim tashkilotlari va ishlab chiqarish korxonalari o‘rtasidagi hamkorlik bu yo‘nalishning rivojlanishini tezlashtiradi.

Xulosa. Anor po‘stlog‘idagi biologik faol moddalar — ellagitanninlar, ellag kislotasi, flavonoidlar va pektin — biotexnologiyada keng qo‘llanish imkoniyatiga ega. Ular ferment yordamida ekstraksiya, mikrobiologik fermentatsiya, nanozarrachalarni yashil sintez qilish, biologik parchalanuvchi qadoqlar yaratish, bioenergetika va tibbiy biotexnologiya yo‘nalishlarida qimmatli xomashyo va substrat vazifasini bajaradi. Po‘stloqni biotexnologik qayta ishlash chiqindilarni kamaytirish, yangi qo‘shilgan qiymat yaratish va chiqindisiz ishlab chiqarishni rivojlantirishga xizmat qiladi. Kelgusi tadqiqotlar mahalliy anor navlarining po‘stlog‘ini o‘rganish, jarayonlarni standartlash va mahsulotlarning xavfsizligini baholashga qaratilishi lozim.

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7. 🌱 ECOLOGY AND AGRICULTURAL INNOVATION: CLIMATE CHANGE, FOOD SECURITY AND RESPONSIBLE RESOURCE USE.

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ALIGNING ANALYTICAL AND ORGANIZATIONAL APPROACHES TO EXPORT MARKET DIVERSIFICATION AMONG ENTERPRISES IN UZBEKISTAN

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Annotatsiya. *Tezisda O‘zbekiston korxonalarining eksport bozorlarini diversifikatsiyalashda tahliliy va tashkiliy yondashuvlarni uyg‘unlashtirish masalalari o‘rganilgan. Xalqaro savdo axborot manbalari tahlili asosida bozorlarni saralash, baholash va o‘zlashtirishni birlashtiruvchi konseptual model taklif etilgan. Bozor jozibadorligi va korxonaning eksportga tayyorligi alohida baholash yo‘nalishlari sifatida belgilangan. Bo‘linmalararo mas’uliyat, sinov savdosi va natijalarni qayta baholash tartibi yoritilgan. Modelni korxonalar ma’lumotlari asosida empirik tekshirish zarurligi qayd etilgan.*

Kalit so‘zlar: *eksport diversifikatsiyasi, tashqi bozor, bozor jozibadorligi, eksportga tayyorlik, tashkiliy boshqaruv, fanlararo hamkorlik.*

Аннотация. *В тезисах рассматривается согласование аналитических и организационных подходов к диверсификации экспортных рынков предприятий Узбекистана. На основе анализа международных торговых информационных ресурсов предложена концептуальная модель отбора, оценки и освоения рынков. Привлекательность рынка и экспортная готовность предприятия выделены как самостоятельные направления оценки. Рассмотрены межфункциональные обязанности, пробные продажи и повторная оценка результатов. Отмечена необходимость эмпирической проверки модели на данных предприятий.*

Ключевые слова: *диверсификация экспорта, внешний рынок, привлекательность рынка, экспортная готовность, организационное управление, междисциплинарное сотрудничество.*

Abstract. *This paper examines the alignment of analytical and organizational approaches to export market diversification among enterprises in Uzbekistan. Based on an analysis of international trade information resources, a conceptual model integrating market screening, assessment, and entry is proposed. Market attractiveness and enterprise export readiness are treated as separate assessment dimensions. Cross-functional responsibilities, pilot sales, and feedback-based*

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reassessment are outlined. The model requires empirical validation using enterprise-level data.

Keywords: *export diversification, foreign market, market attractiveness, export readiness, organizational management, interdisciplinary cooperation.*

Introduction

In this study, export market diversification is understood as expanding an enterprise's geographical sales base while managing dependence on individual buyers or countries. The objective is not merely to increase the number of markets served, but to establish commercially viable and sustained export relationships.

The International Trade Centre's Trade Map provides information on international demand, export performance, alternative markets, and competition. Export Potential Map translates trade analysis into practical information on export opportunities. These tools support initial market selection, but their findings must be assessed against enterprise resources and organizational capabilities.

The study aims to develop a conceptual model aligning analytical and organizational approaches to export market diversification among enterprises in Uzbekistan. Its objectives are to establish market selection criteria, assess export readiness, and assign responsibilities for market entry.

Research Methods

The study employs comparative analysis of international trade information resources, synthesis, multi-criteria assessment, and conceptual modelling. Sources were selected to cover demand, competition, market access, logistics, and trade procedures.

Market assessment criteria were first identified and then linked to enterprise capabilities and management tasks. No enterprise-level calculations were conducted; therefore, the model is presented as a proposal requiring practical validation.

Research Results

Market Attractiveness and Export Readiness

The model distinguishes between two questions: "Which markets offer attractive opportunities?" and "Is the enterprise ready to enter them?" The former concerns external conditions, while the latter addresses internal capabilities.

World Tariff Profiles 2025 provides information on tariffs and non-tariff measures across more than 170 countries and customs territories. Product-specific requirements nevertheless require verification through relevant official sources. The World Bank's logistics assessment offers initial guidance on customs clearance, service quality, tracking, and delivery performance, but country-level indicators cannot replace route-specific cost and transit-time estimates.

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Table 1

Proposed Criteria for Export Market Selection

Assessment dimension	Main criteria	Decision-making purpose
Demand and competition	Import value and trends, supplier composition	Identify market opportunities
Market access	Tariffs, certification, labelling, and other requirements	Assess entry costs and constraints
Logistics	Delivery time, transport costs, route reliability	Evaluate order fulfilment feasibility
Financial readiness	Working capital, payment terms, receivables risk	Determine financing needs
Production and management	Capacity, quality, documentation, responsible personnel	Assess operational readiness

Compliance with mandatory requirements is checked before comparing market attractiveness. Strong demand should not compensate for an inability to obtain required certification or fulfil production commitments.

From Analysis to Organizational Action

The proposed model follows this sequence:

Market screening → attractiveness and readiness assessment → priority market selection → entry planning → pilot sales → reassessment.

A concise market-entry profile is prepared for each priority market. It identifies target buyers, product requirements, prices and costs, payment terms, sales channels, responsible personnel, and pilot evaluation criteria.

Uzbekistan Trade Info provides step-by-step information on export, import, and transit procedures. This information can inform the enterprise's documentation and clearance schedule

Responsibilities are distributed across functions: marketing assesses demand and buyers; production evaluates product adaptation; finance examines profitability and payment terms; and logistics compares delivery options. A designated coordinator consolidates these assessments for management review.

Performance Assessment

Diversification should not be evaluated solely by the number of new destination countries. Proposed indicators include:

- export revenue and profitability in new markets;
- the proportion of buyers placing repeat orders;
- time required to secure the first commercial order;
- market-entry and product adaptation costs;
- the largest destination market's share of total exports.

Geographical concentration may additionally be assessed using:

$$H = \sum_{j=1}^{m} s_j^2 ,$$

where s_j is destination j's share of enterprise exports, expressed as a fraction, and m is the number of destination markets. Under consistent classifications and reporting periods, a declining index indicates lower geographical concentration. It does not, however, automatically imply higher profitability or lower overall risk.

Discussion

The model's principal contribution is to connect market analysis with specific tasks, resources, and responsibilities rather than merely producing market rankings. For example, strong demand combined with substantial certification costs may justify phased product adaptation and pilot sales instead of immediate large-scale entry.

Its interdisciplinary dimension combines trade statistics, marketing, finance, logistics, and quality management within a shared decision-making process. Global market developments are thereby translated into practical enterprise-level actions.

Limitations include reporting delays, differences within product categories, and subjective assessments. Preliminary findings should therefore be checked through buyer negotiations, current delivery quotations, and pilot orders.

Conclusion

The study proposes a conceptual model that separately assesses market attractiveness and enterprise export readiness, then integrates both into an organizational action plan. The model covers market selection, entry planning, pilot sales, and reassessment.

Implementation should prioritize mandatory requirements, structured market-entry profiles, and clear cross-functional responsibilities. Its effectiveness requires empirical evaluation using export profitability, repeat orders, and changes in market concentration.

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QALPOQCHALI ZAMBURUG'LAR VA MAHALLIY O'SIMLIK XOMASHYOSI ASOSIDA FUNKSIONAL XUSUSIYATLARGA EGA TEZ TAYYORLANADIGAN OZIQ-OVQAT MAHSULOTINI ISHLAB CHIQISH TEXNOLOGIYASI

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Annotatsiya. *Maqolada qalpoqchali zamburug'lar (Pleurotus, Agaricus, Lentinula turlari) va mahalliy o'simlik xomashyosi asosida funksional xususiyatlarga ega, tez tayyorlanadigan (instant) quruq oziq-ovqat mahsulotini ishlab chiqishning ilmiy asoslari ko'rib chiqilgan. Xorijiy sharh maqolalar tahlili asosida zamburug' ingredientlarining ozuqaviy tarkibi, texnofunksional xususiyatlari va qayta ishlash sharoitiga bog'liqligi yoritilgan. Muallif zamburug'ning funksionalligi xomashyoning o'zida emas, balki qayta ishlash jarayonida shakllanadi, degan fikrni asoslaydi va quritish, maydalash hamda donli va dukkakli xomashyo bilan uyg'unlashtirishni o'z ichiga olgan texnologik sxemani taklif etadi.*

Kalit so'zlar: *qalpoqchali zamburug'lar, Pleurotus, instant mahsulot, funksional oziq-ovqat, β-glyukanlar, zamburug' kukuni, mahalliy xomashyo.*

Аннотация. *В статье рассмотрены научные основы разработки функционального быстрорастворимого (инстант) сухого пищевого продукта на основе шляпочных грибов (виды Pleurotus, Agaricus, Lentinula) и местного растительного сырья. На основе анализа зарубежных обзорных статей освещены пищевой состав грибных ингредиентов, их технофункциональные свойства и зависимость от условий переработки. Автор обосновывает мнение, что функциональность гриба формируется не в самом сырье, а в процессе переработки, и предлагает технологическую схему, включающую сушку, измельчение и сочетание со злаковым и бобовым сырьем.*

Ключевые слова: *шляпочные грибы, Pleurotus, инстант-продукт, функциональные продукты питания, β-глюканы, грибной порошок, местное сырье.*

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Abstract. *The article examines the scientific basis for developing a functional quick-preparation (instant) dry food product based on cap mushrooms (Pleurotus, Agaricus and Lentinula species) and local plant raw materials. Based on an analysis of foreign review articles, the nutritional composition and techno-functional properties of mushroom ingredients and their dependence on processing conditions are described. The author substantiates the view that the functionality of a mushroom is formed not in the raw material itself but during processing, and proposes a technological scheme that includes drying, grinding, and combination with cereal and legume raw materials.*

Keywords: *cap mushrooms, Pleurotus, instant product, functional food, β-glucans, mushroom powder, local raw materials.*

Kirish

Funksional oziq-ovqat bozori hajmining 2025 yildagi taxminan 388,8 mlrd dollardan 2035 yilda 901 mlrd dollargacha o'sishi kutilmoqda [2]. Zamburug'li ichimliklar daromadining 85,22 foizi kukun mahsulotlarga to'g'ri kelgan, chunki ular universal va uzoq saqlanadi [3]; tez tayyorlanadigan quruq mahsulotlar zamburug' ingredientlarini yetkazishning eng qulay shaklidir.

Qalpoqchali zamburug'lar quruq vaznda 19–35 foiz oqsil, 50–65 foiz uglevod, 2–6 foiz yog', 16–53 foiz oziq tolasi va 6–9 foiz minerallar tutadi [1, 2]. Ularda β-glyukanlar, ergosterol (D_2 provitamini), B guruhi vitaminlari, fenol birikmalari, umami beruvchi glutamin kislotasi va 5′-nukleotidlar bor [1, 4]. Biroq yangi Pleurotus xona haroratida 24–48 soat, sovutgichda 7–10 kun saqlanadi [4], shuning uchun uni quruq kukunga aylantirish amaliy qo'llashning asosiy sharti hisoblanadi.

Mazkur tadqiqotning maqsadi qalpoqchali zamburug'lar va mahalliy o'simlik xomashyosi asosida funksional xususiyatlarga ega instant mahsulot ishlab chiqish texnologiyasining ilmiy asoslarini aniqlashdan iborat. Ishda 2023–2026 yillarda e'lon qilingan to'rtta xalqaro sharh maqola [1–4] tahlil qilindi; miqdoriy ko'rsatkichlar adabiyotdan olingan, muallif taklif etgan retseptura va rejimlar esa eksperimental tekshiruvni talab qiluvchi ishchi farazlardir.

Muhokama va natijalar

1. Funksionallik xomashyoning emas, jarayonning natijasidir. Zamburug' ingredientlarining suv va yog' ushlab turish, emulsiya va gel hosil qilish xususiyatlari ekstraksiya va qayta ishlash sharoitiga kuchli bog'liq [1]: ultratovush ekstraksiyasi A. bisporus polisaxaridlari unumini 6,02 foizgacha oshirgan, ammo gel hosil qilishni yaxshilamagan; tozalikni oshirish esa β-glyukan unumini 9,05 foizdan 0,16 foizgacha kamaytirgan. Shu sababli muallif hujayra devori va β-glyukan tuzilmasini saqlash uchun yumshoq rejimlarni (past harorat, qisqa ishlov) afzal

biladi; butun qalpoq kukuni unum, tozalik va funksionallik o'rtasidagi kelishuvni arzon hal qiladi.

2. Optimal qo'shish miqdori. Ritota va Manzi tahliliga ko'ra, quruq Pleurotus kukunini 4–10 foiz qo'shish ozuqaviy ko'rsatkichlarni yaxshilaydi va organoleptik xususiyatlarni saqlaydi [4]; yuqori miqdorda hajm, tekstura va ta'm yomonlashadi [1]. Muallif 5–10 foizni ishchi diapazon qilib, uni to'rt darajada (5; 7,5; 10; 12,5 foiz) sinashni taklif etadi.

3. Oziq tolasi bo'yicha hisob. Kukun tolasi 16–53 foiz bo'lgani uchun [2], 10 foiz qo'shilganda aralashmaga zamburug'dan 1,6–5,3 g/100 g tola tushadi. Yevropa Ittifoqida "tola manbai" uchun kamida 3 g, "tolaga boy" uchun 6 g/100 g talab qilinadi [4], shuning uchun funksional da'voga zamburug' kukunini donli xomashyo tolasi bilan birlashtirib erishish mumkin.

4. Oqsil va aminokislotalarni to'ldirish. Donlilarda lizin, dukkaklilarda oltingugurtli aminokislotalar yetishmaydi [2, 4], zamburug' esa almashtirib bo'lmaydigan aminokislotalarga boy [2]. Muallif fikricha, bug'doy yoki guruch uni, mosh yoki no'xat uni va zamburug' kukunidan iborat uch komponentli asos aminokislota balansi bo'yicha yaxshi to'ldirilgan va mahalliy xomashyoga tayanadigan eng istiqbolli yechimdir.

5. Quritish va rang. Instant mahsulot sifati quritish rejimiga bog'liq: Pleurotus bo'laklarini 45 °C da quritish rangni eng yaxshi saqlagan, 55 va 65 °C da esa yorqinlik pasayib, sarg'ayish ortgan [4]; vakuumli quritish termosezgir birikmalar uchun qulay, issiq havoda quritish esa regidratatsiyani pasaytiradi [1, 4]. Muallif 45 °C atrofida quritishni (oldin blanshirovka va limon kislotasi bilan ishlov) hamda vakuumli yoki sublimatsion usulni solishtirishni taklif qiladi.

6. Qalpoq va oyoqchaning alohida ishlatilishi. Oyoqcha ko'pincha chiqindiga chiqariladi, holbuki undan β-glyukanga boy ekstraktlar olib, emulsiya barqarorlashtiruvchi sifatida ishlatish mumkin [1, 2]; muallif qalpoqni asosiy kukun, oyoqchani esa alohida tola yoki β-glyukan ingredienti sifatida ishlatishni taklif etadi (chiqitsiz texnologiya).

7. Ta'm, umami va tuzni kamaytirish. Glutamin kislotasi va 5′-nukleotidlar sinergiyasi umami ta'mini kuchaytirib, tuzni kamaytirishga imkon beradi [1, 4], biroq Yevropada sinovdan o'tgan birinchi marta iste'mol qiluvchilarning 68 foizi dorivor zamburug'li ichimliklarni rad etgan [3]. Muallif ta'mni ziravorlar, sabzavot kukunlari va mikrokapsulalash (92 foiz samaradorlik [3]) yordamida yumshatishni tavsiya etadi.

8. Fermentatsiya orqali boyitish. Pleurotus bilan qattiq fazali fermentatsiya antiozuqaviy moddalarni kamaytiradi, oqsil va fenollarni oshiradi, guruchni fermentlash esa β-glyukan miqdorini oshirgan [2, 4].

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Taklif etilayotgan texnologik sxema

Muallif quyidagi ketma-ketlikni ishchi sxema sifatida taklif etadi:

1. Qabul qilish, saralash, yuvish (og'ir metallar nazorati), qalpoq va oyoqchani ajratish.
2. Blanshirovka, limon kislotasi bilan ishlov, quritish (45 °C; solishtirish uchun vakuumli).
3. Maydalash, elash va mahalliy xomashyo (bug'doy yoki guruch uni, mosh yoki no'xat uni, qovoq yoki sabzi kukuni) bilan aralashtirish (zamburug' 5–10 foiz).
4. Agglomeratsiya, namlik o'tkazmaydigan qadoqlash, sifat nazorati (namlik, suv faolligi, oqsil, tola, rang, regidratatsiya, mikrobiologik va og'ir metallar ko'rsatkichlari).

Xulosa

Qalpoqchali zamburug'lar kukuni mahalliy donli va dukkakli xomashyo bilan birgalikda tez tayyorlanadigan funksional mahsulotning ilmiy asosli bazasi bo'la oladi: funksionallik qayta ishlashda shakllanadi, shuning uchun yumshoq quritish va minimal tozalash afzal; 5–10 foiz qo'shish ta'm va ozuqaviy qiymat muvozanatini beradi; don, dukkakli va zamburug' uyg'unligi aminokislota balansini yaxshilab, tola bo'yicha funksional da'voga yo'l ochadi; qalpoq va oyoqchani alohida ishlatish chiqitsiz texnologiyani ta'minlaydi. Retseptura va rejimlarni laboratoriyada sinash, shuningdek og'ir metallar to'planishi va klinik tasdiqning yetishmasligi (da'volarning atigi 23 foizi talablarga javob beradi [3]) sababli xavfsizlik va standartlashtirishni o'rganish zarur.

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QASHQADARYO VILOYATI SUV OMBORLARINING ATROF MUHITGA TA'SIRI (HISORAK SUV OMBORI MISOLIDA)

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Annotatsiya. *Maqolada Qashqadaryo viloyati suv omborlarining atrof muhitga ta'siri Hisorak suv ombori (Shahrisabz tumani, Oqsuv daryosi havzasi) misolida ochiq ilmiy va rasmiy manbalar asosida tahlil qilingan. Suv omborining morfometrik ko'rsatkichlari, uning daryo oqimi rejimiga, bug'lanish orqali suv yo'qotilishiga, oqiziqlar bilan to'lishiga, mikroiqlim va sizot suvlariga, biota hamda texnogen xavfsizlikka ta'siri ko'rib chiqilgan. Gapparov va Sarmonov (2023) ma'lumotlari asosida Hisorak suv ombori yuzasidan yillik bug'lanish 1221 mm ekanligi, eng yuqori sathda bu yo'qotish yiliga taxminan 6,8 mln m³ (loyihaviy hajmning ≈4 foizi) bo'lishi hisoblab ko'rsatilgan. Tog'li hududdagi Hisorak tekislikdagi Talimarjon suv omboriga nisbatan bug'lanishdan taxminan 22 foiz kam yo'qotadi. Maqola oxirida suv omborining atrof muhitga ta'sirini kamaytirish bo'yicha monitoring va boshqaruv tavsiyalari berilgan.*

Kalit so'zlar: *suv ombori, Hisorak, Qashqadaryo viloyati, atrof muhitga ta'sir, bug'lanish, oqiziqlar, mikroiqlim, Oqsuv daryosi.*

Аннотация. *В статье на основе открытых научных и официальных источников проанализировано влияние водохранилищ Кашкадарьинской области на окружающую среду на примере водохранилища Гисарак (Шахрисабзский район, бассейн реки Аксу). Рассмотрены морфометрические характеристики водохранилища, его влияние на режим речного стока, потери воды на испарение, заиление, микроклимат, грунтовые воды, биоту и техногенную безопасность. По данным Гаппарова и Сармонова (2023), годовое испарение с поверхности водохранилища Гисарак составляет 1221 мм, а при максимальном уровне потери оцениваются примерно в 6,8 млн м³ в год (около 4 % проектного объёма). Горное водохранилище Гисарак теряет на испарение примерно на 22 % меньше, чем равнинное Талимарджанское. В заключение даны рекомендации по мониторингу и управлению.*

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Ключевые слова: *водохранилище, Гисарак, Кашкадарьинская область, воздействие на окружающую среду, испарение, наносы, микроклимат, река Аксу.*

Abstract. *Based on open scientific and official sources, the article analyses the environmental impact of reservoirs in the Kashkadarya region using the Hisorak reservoir (Shahrisabz district, Oqsuv river basin) as a case study. It considers the reservoir's morphometric characteristics and its effects on river flow regime, evaporation losses, siltation, microclimate, groundwater, biota and technogenic safety. According to Gapparov and Sarmonov (2023), annual evaporation from the Hisorak surface is 1221 mm; at the maximum level this corresponds to roughly 6.8 million m³ per year (about 4% of the design volume). The mountain-situated Hisorak loses about 22% less water to evaporation than the lowland Talimarjon reservoir. The article concludes with recommendations for monitoring and management.*

Keywords: *reservoir, Hisorak, Kashkadarya region, environmental impact, evaporation, sediment, microclimate, Oqsuv river.*

Kirish

O‘zbekiston qurg‘oqchil mintaqada joylashgan bo‘lib, qishloq xo‘jaligi, ichimlik suvi ta’minoti va energetika suv resurslarining yil davomida kafolatli taqsimlanishiga bog‘liq. Daryo oqimining yil ichidagi notekisligini tartibga solishning asosiy vositasi — suv omborlaridir. Biroq suv omborlari faqat ijobiy omil emas: ular tabiiy daryo rejimini o‘zgartiradi, suv yuzasidan bug‘lanishni oshiradi, oqiziqlarni to‘playdi, atrofdagi yerlarning gidrogeologik va mikroiqlimiy sharoitiga ta’sir ko‘rsatadi [8; 9].

Qashqadaryo viloyatida taxminan o‘nga yaqin suv ombori mavjud bo‘lib, ularning eng yirigi Chimqo‘rg‘on (500 mln m³) [4], shuningdek, Pachkamar, Qamashi, Talimarjon va Hisorak suv omborlaridir. Viloyatda iqlim kontinental-subtropik bo‘lib, yog‘in miqdori g‘arbdan sharqqa, balandlik ortgani sari ko‘payadi: 1980–2022 yillar bo‘yicha o‘rtacha ko‘p yillik yog‘in Muborakda 193 mm, Qarshida 253 mm, Shahrisabzda esa 551 mm ni tashkil etgan [3]. Bunday sharoitda suv omborlari viloyat iqtisodiyoti uchun strategik ahamiyatga ega, shu bilan birga ularning ekologik oqibatlarini baholash dolzarb ilmiy vazifadir.

Hisorak suv ombori Shahrisabz shahridan taxminan 35 km uzoqlikda joylashgan va Shahrisabz, Kitob, Chiroqchi hamda Yakkabog‘ tumanlaridagi sug‘oriladigan yerlarni suv bilan ta’minlaydi [1]. Shunga qaramay, mazkur suv omborining atrof muhitga ta’siri bo‘yicha tizimli ilmiy tahlillar cheklangan, ma’lumotlar turli manbalarda tarqoq holda uchraydi. Tadqiqotning maqsadi — mavjud ochiq ma’lumotlarni umumlashtirib, Hisorak suv ombori misolida viloyat

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suv omborlarining atrof muhitga ta’sirini tahlil qilish va monitoring yo‘nalishlarini belgilashdir.

Tadqiqot obyekti va usullari

Tadqiqot obyekti — Qashqadaryo viloyati Shahrisabz tumanida Oqsuv daryosida joylashgan Hisorak suv ombori. Maqolada quyidagi usullardan foydalanildi: ilmiy va rasmiy manbalarning qiyosiy tahlili; suv omborining morfometrik va gidrologik ko‘rsatkichlarini umumlashtirish; bug‘lanish ma’lumotlari asosida suv balansi tarkibiy qismini hisoblash; oqiziqlar bo‘yicha gidrologik post ma’lumotlarining dinamik tahlili; ta’sir omillarini sifat jihatdan tasniflash.

Bug‘lanish bo‘yicha asosiy ma’lumotlar Gapparov va Sarmonovning (2023) tog‘li hududlar uchun GGI formulasi $E = 0{,}19 \cdot n \cdot (e_0 - e_{200}) \cdot (1 + 0{,}51 \cdot U_{200})$ asosidagi hisob-kitoblaridan olindi, bunda e_0 — suv yuzasi haroratiga mos to‘yingan bug‘ bosimi, e_{200} — 200 sm balandlikdagi haqiqiy bug‘ bosimi, U_{200} — shamol tezligi, n — davrdagi kunlar soni [2]. Ushbu ma’lumotlardan hajmiy yo‘qotish ($W = E \cdot F$) muallif tomonidan jadvaldagi eng yuqori sath yuzasi bo‘yicha qayta hisoblandi. Qashqadaryo daryosi bo‘yicha oqiziqlar ma’lumotlari Eshev va boshqalar (2023) keltirgan Chiroqchi gidrologik posti kuzatuvlariga tayanadi [3].

Eslatma: Hisorak suv omborining ayrim ko‘rsatkichlari (jumladan, suv yuzasi maydoni) manbalarda turlicha keltirilgan, shu sababli ular qiymat oralig‘i sifatida berildi. Rasmiy loyiha ma’lumotlari bilan solishtirish tavsiya etiladi.

Natijalar va muhokama

Hisorak suv omborining tabiiy-geografik o‘rni va asosiy ko‘rsatkichlari

Hisorak suv omborining qurilishi 1977 yilda boshlangan, 1988 yilda yakunlangan va sinovlar hamda to‘g‘onni qo‘shimcha mustahkamlash ishlaridan so‘ng 1990 yilda foydalanishga qabul qilingan. Asosiy suv manbai — Hisor tizmasidan oqib tushuvchi Oqsuv daryosi [1]. Dastlab inshootda GES bo‘lmagan; 2011 yilda yiliga 80,9 mln kVt·soat elektr energiyasi ishlab chiqaradigan GES foydalanishga topshirilgan [1]. 1-jadvalda asosiy ko‘rsatkichlar keltirilgan.

1-jadval. Hisorak suv omborining asosiy ko‘rsatkichlari

Ko‘rsatkich	Qiymat	Manba
Qurilish davri / foydalanishga qabul	1977–1988 / 1990 yil	[1]
To‘liq (loyihaviy) hajm	170 mln m³	[1]
Tavsiya etilgan foydali hajm	161 mln m³	[1]
«O‘lik hajm»	8,4 mln m³	[1]
Suv yuzasi maydoni	4,1 km² [1]; hisob jadvalida eng yuqori sathda 5,65 km² [2]	[1; 2]

Ko‘rsatkich	Qiymat	Manba
Uzunligi	6,8 km	[1]
Sug‘oriladigan yer maydoni	49 ming gektar (4 tuman)	[1]
GES quvvati bo‘yicha yillik ishlab chiqarish	80,9 mln kVt·soat (2011 yildan)	[1]

Daryo oqimi va gidrologik rejimga ta’siri

Suv ombori Oqsuv daryosining tabiiy yillik rejimini sezilarli o‘zgartiradi: bahor-yoz davridagi ko‘p suvli oqim to‘planib, sug‘orish mavsumiga qayta taqsimlanadi. Bu sug‘orma dehqonchilik uchun ijobiy, biroq quyi oqimdagi tabiiy suv-botqoq ekotizimlariga yetib boradigan suv hajmi va uning mavsumiy dinamikasi o‘zgaradi. Umumiy ilmiy qonuniyat sifatida, to‘g‘on quyi oqimda toshqin cho‘qqilarini kamaytirib, daryo o‘zani morfologiyasi va qirg‘oq o‘simliklarining yangilanish sharoitlarini o‘zgartirishi ta’kidlanadi [8; 9].

Eshev va boshqalar (2023) tahliliga ko‘ra, qor va muzliklardan to‘yinadigan Oqsuv daryosidan Hisorak suv omboriga keladigan suv hajmi muzliklarning iqlim o‘zgarishi tufayli erishi natijasida yillar bo‘yicha ko‘payganligi kuzatilgan, yomg‘irdan to‘yinadigan Qashqadaryodan Chimqo‘rg‘on suv omboriga keladigan hajm esa kamayib bormoqda [3]. Bu holat Hisorakni viloyatdagi boshqa suv omborlariga nisbatan barqarorroq to‘yinish manbaiga ega ekanini ko‘rsatadi, lekin muzliklar zahirasi qisqarishi bilan bu ustunlik uzoq muddatda saqlanib qolmasligi mumkin — buning uchun muzliklar balansi bo‘yicha alohida tadqiqot zarur.

Shuningdek, mintaqada kam suvli davrlar chastotasi o‘zgarmoqda: 1970-yillargacha suv tanqisligi yillari har 10–12 yilda kuzatilgan bo‘lsa, so‘nggi 40 yilda har 4–6 yilda takrorlanmoqda [3; 13]. Bu suv omborlari zahirasiga bosimni oshirib, ularni boshqarishning ekologik jihatlarini yanada muhim qiladi.

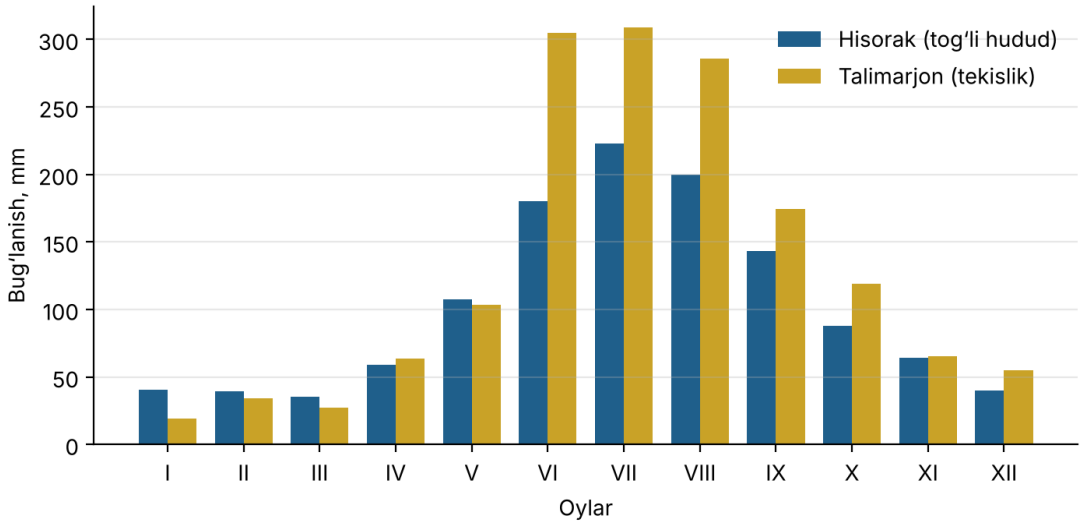
Bug‘lanish va suv balansiga ta’siri

Suv omborlari ochiq suv yuzasini hosil qilgani uchun bug‘lanish orqali qaytmas yo‘qotish yuzaga keladi. Gapparov va Sarmonov (2023) hisoblariga ko‘ra, Hisorak suv ombori yuzasidan yillik bug‘lanish 1221,01 mm, tekislikdagi Talimarjon suv omborida esa 1561,64 mm ni tashkil etadi [2]. Ya’ni tog‘li hududdagi suv ombori bug‘lanishdan taxminan 21,8 foiz kam suv yo‘qotadi. Buning sababi past havo harorati, nisbatan sust shamol tezligi (Hisorakda 1,3–1,7 m/s, Talimarjonda 2,6–3,9 m/s) va kichikroq suv yuzasidir [2]. Oylik qiymatlar 2-jadval va 1-rasmda keltirilgan.

2-jadval. Hisorak va Talimarjon suv omborlari yuzasidan oylik bug‘lanish, mm (2022 yil hisobi)

Suv ombori	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yil
Hisorak	41	39	35	59	108	180	223	200	143	88	64	40	1221
Talimarjon	19	34	27	64	103	305	309	286	175	119	66	55	1562

Eslatma: jadvalda qiymatlar butun songacha yaxlitlangan; aniq qiymatlar manbada [2] keltirilgan (Hisorak — 1221,01 mm, Talimarjon — 1561,64 mm).



1-rasm. Hisorak va Talimarjon suv omborlari yuzasidan oylik bug‘lanish (ma’lumot manbasi: [2])

Hisorak uchun iyun–avgust oylarida bug‘lanish 603 mm ni, ya’ni yillik qiymatning taxminan 49 foizini tashkil etadi; bu sug‘orish talabi eng yuqori bo‘lgan davrga to‘g‘ri keladi. Mualliflar jadvaliga ko‘ra, 1135 m sathda suv yuzasi 5,65 km² bo‘lganda oylik hajmiy bug‘lanish yoz oylarida 1,0–1,3 mln m³ ga yetadi [2]. Oylik qiymatlarni qo‘shib chiqilganda yillik yo‘qotish taxminan 6,8 mln m³ ni beradi, bu loyihaviy hajmning (170 mln m³) taxminan 4 foizi. Bu yo‘qotish tizimli ravishda suv omboridan kutiladigan foydali oqimni kamaytiradi va uning ahamiyati suv tanqis yillarda yanada oshadi. Shuni ta’kidlash lozimki, bu hisob suv yuzasining eng yuqori sathga mos qiymati bo‘yicha bajarilgan; amalda sath mavsum davomida o‘zgargani uchun o‘rtacha yo‘qotish pastroq bo‘lishi mumkin.

Oqiziqlar, loyqalanish va eroziya

Suv omborlari ekologik jihatdan daryo oqiziqlarining to‘siq sifatida ushlanib qolishiga olib keladi: global tahlillar bunday ushlanishning daryo tizimlariga sezilarli ta’sirini ko‘rsatgan [10; 11]. Natijada suv ombori hajmi vaqt o‘tishi bilan loyqa bilan to‘lib boradi, quyi oqimga esa tarkibida oqiziq kam («och») suv tushib, o‘zan eroziyasi kuchayishi mumkin.

Viloyat daryolarida oqiziqlar konsentratsiyasi ortib borayotgani kuzatilgan. Eshev va boshqalar (2023) keltirgan Qashqadaryo daryosining Chiroqchi posti ma'lumotlariga ko'ra, loyqa oqiziqlar konsentratsiyasi 2012 yildagi 300 g/m³ dan 2020 yilda 1300 g/m³ gacha yetgan (3-jadval); 2012–2021 yillardagi o'rtacha qiymat 690 g/m³ ni tashkil etadi [3]. Mualliflar buni oqimning qor bilan to'yinishdan yomg'ir bilan to'yinishga o'tishi, bahordagi qisqa muddatli jadal yog'inlar ulushi oshishi, tuproq eroziyasi kuchayishi va suv omborlarining tezroq loyqalanishiga olib kelishi bilan izohlaydi [3].

3-jadval. Qashqadaryo daryosi, Chiroqchi posti: o'rtacha yillik suv sarfi va oqiziqlar konsentratsiyasi [3]

Yil	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Q, m³/s	14.6	13.3	9.64	21.2	16.6	18.3	8.54	27.2	26	8.82
P, g/m³	300	640	720	870	860	860	470	470	1300	410

Muhim izoh: 3-jadval to'g'ridan-to'g'ri Oqsuv daryosiga emas, balki Qashqadaryo havzasiga tegishli; uni Hisorak uchun kuzatiladigan umumiy mintaqaviy xavf — eroziya va loyqalanish tendensiyasining ko'rsatkichi sifatida qarash o'rinli. Hisorakning o'zi uchun batimetrik o'lchovlar orqali haqiqiy loyqalanish tezligini aniqlash zarur.

Mikroiqlim, sizot suvlari va yerlarning melioratsiya holati

Katta suv yuzasi atrofda havo namligini oshirib, harorat amplitudasini yumshatadi: suv ombori yilning sovuq oylarida atrofga issiqlik beruvchi, issiq oylarda esa sovituvchi omil bo'ladi. Gapparov va Sarmonov hisoblariga ko'ra, suv yuzasi harorati sovuq oylarda havo haroratidan yuqori bo'lib, farq 4–7 °C oralig'ida o'zgaradi [2]. Bu hisoblangan suv harorati bo'lib, mikroiqlimga ta'sir mexanizmini ko'rsatadi; alohida meteorologik o'lchovlarsiz atrof hududdagi o'zgarish miqdorini aniq aytib bo'lmaydi.

Suv omborlari va ularga ulanuvchi kanallar sizishi hisobiga atrofdagi sizot suvlari sathining ko'tarilishi, ayrim hollarda tuproq sho'rlanishining kuchayishi umumiy qonuniyat sifatida e'tirof etiladi [8; 9]. Qashqadaryo viloyatida so'nggi suv tanqis yillarda sug'orish uchun yer osti suvlaridan jadal foydalanilishi ularning sathi pasayishiga va sho'rligi yuqori bo'lgan suvlar ishlatilganda sho'rlangan maydonlar kengayishi xavfiga olib kelgani qayd etilgan [3]. Shu sababli Hisorak ta'sir zonasida sizot suvlari sathi va minerallashuvini muntazam kuzatib borish zarur; bunday kuzatuv natijalari ochiq manbalarda yetarli darajada keltirilmagan.

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Biota va landshaft o‘zgarishi

Suv ombori barpo etilishi bilan vodiy qismi ostida qolgan quruqlik ekotizimlari yo‘qoladi, o‘rniga yangi suv-qirg‘oq biotoplari shakllanadi. Qashqadaryo viloyatidagi yirik suv omborlarida baliq faunasi shakllanganligi, ular orasida Pachkamar, Chimqo‘rg‘on, Qamashi, Hisorak va Talimarjon yirik suv havzalari sifatida qayd etilgani adabiyotlarda keltiriladi [5]. Biroq Hisorak bo‘yicha biologik xilma-xillikning aniq inventarizatsiyasi (ornitofauna, ixtiofauna, qirg‘oq o‘simliklari) ochiq manbalarda yetarli emas. Suv omborlaridagi suv sifati va suv sathi o‘zgarishi baliqlar nobud bo‘lishi kabi hodisalarga olib kelishi mumkin; viloyatning Talimarjon suv omborida bunday holatlar ommaviy axborotda muhokama qilingan, shu sababli har bir suv omborida gidrokimyoviy va gidrobiologik monitoring muhimdir.

Landshaft nuqtai nazaridan Hisorak atrofidagi hudud Hisor tizmasining tog‘oldi va o‘rta tog‘ qismida bo‘lib, suv omborining rekreatsion va turistik salohiyati mavjudligi ommaviy axborotda qayd etilgan [1]. Rekreatsiyaning rivojlanishi esa qirg‘oq zonasiga antropogen yukni oshiradi, shuning uchun suv muhofaza zonalari va chiqindi boshqaruvi bo‘yicha qat’iy me’yorlar zarur.

Texnogen xavfsizlik va infratuzilma xavfi

Suv ombori to‘g‘onlari atrof muhit uchun potensial texnogen xavf manbai hisoblanadi. 2024 yil 10 iyunda ijtimoiy tarmoqlarda Hisorak to‘g‘oni yorilgani haqida xabarlar tarqalgan; Favqulodda vaziyatlar vazirligi bergan ma’lumotga ko‘ra, to‘g‘onning chap tomonida qo‘shimcha tunnel ochish bo‘yicha olib borilgan texnik ishlar vaqtida suv sizib chiqqan, hech kim jarohatlanmagan va inshoot shtat rejimida ishlagan [6; 7]. Bu holat ikki muhim xulosani beradi: birinchidan, to‘g‘on xavfsizligi monitoringi va tezkor axborot berish tizimi muhim; ikkinchidan, inshootlarning texnik holati va rasmiy ma’lumotlarning ochiqligi aholining ishonchi hamda ekologik xavfsizlikka bevosita ta’sir qiladi.

Shuningdek, Hisorak suv omboridan ichimlik suvi olib kelish loyihasini jadallashtirish vazifasi 2026 yil iyulida qo‘yilgani xabar qilingan [14]; bu suv omborining ekologik-ijtimoiy ahamiyati ortib borayotganini va uning suv sifati monitoringini kuchaytirish zarurligini ko‘rsatadi.

Ta’sirlar umumlashmasi

Tahlil natijalari 4-jadvalda ijobiy va salbiy ta’sirlar sifatida umumlashtirildi. Jadvaldagi «Asos» ustunida har bir xulosa raqamli ma’lumotga yoki umumiy ilmiy qonuniyatga tayanishi ko‘rsatilgan.

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4-jadval. Hisorak suv omborining atrof muhitga ta’sirlari

Yo‘nalish	Xarakteri	Mazmuni	Asos
Suv ta’minoti	Ijobiy	4 tumanda 49 ming ga yerni sug‘orish imkoniyati; oqimni mavsumga qayta taqsimlash	[1]
Energetika	Ijobiy	GES orqali yiliga 80,9 mln kVt·soat energiya	[1]
Suv balansi	Salbiy	Bug‘lanishdan yillik 1221 mm (≈6,8 mln m³, eng yuqori sathda)	[2], muallif hisobi
Oqiziqlar	Salbiy (xavf)	Havzada eroziya va loyqa konsentratsiyasi ortishi; hajmning qisqarishi xavfi	[3; 10; 11]
Daryo rejimi	Aralash	Quyi oqimda tabiiy mavsumiy rejim va toshqinlar o‘zgarishi	[8; 9]
Mikroiqlim	Aralash	Suv yuzasi va havo harorati farqi (4–7 °C) orqali haroratni yumshatish	[2]
Sizot suvlari / sho‘rlanish	Salbiy (xavf)	Sath ko‘tarilishi va sho‘rlanish xavfi — dala monitoringi talab etiladi	[3; 8]
Biota	Aralash	Yangi suv biotoplari, ammo quruqlik ekotizimlarining yo‘qolishi	[5; 8]
Texnogen xavfsizlik	Xavf omili	To‘g‘on holati va tezkor axborot berish ahamiyati (2024 yil holati)	[6; 7]

Tavsiyalar

• Hisorak suv omborida muntazam batimetrik o‘lchovlar o‘tkazib, haqiqiy loyqalanish tezligi va foydali hajm dinamikasini aniqlash.

• Oqsuv daryosi va suv omboridagi suvning gidrokimyoviy hamda gidrobiologik monitoringini yo‘lga qo‘yish (minerallashuv, biogen moddalar, erigan kislorod).

• Suv ombori ta’sir zonasida sizot suvlari sathi va minerallashuvi hamda tuproq sho‘rlanishi bo‘yicha doimiy kuzatuv nuqtalari tarmog‘ini tashkil etish.

• Suv yuzasi maydoni bo‘yicha rasmiy ma’lumotlarni aniqlashtirib, bug‘lanish yo‘qotishlarini real sath dinamikasi asosida mavsumiy hisoblash.

• Suv ombori havzasida eroziyaga qarshi tadbirlarni (qiyaliklarni o‘simlik bilan mustahkamlash, terrasalash) rejalashtirish.

• Qirg‘oq zonasi uchun suv muhofaza zonalari va rekreatsion yuk me’yorlarini belgilash; ichimlik suvi manbai sifatida foydalanishda suv sifati nazoratini kuchaytirish.

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• To‘g‘on xavfsizligi bo‘yicha texnik holat hisobotlari va monitoring natijalarini jamoatchilik uchun ochiq qilish.

Xulosa

Hisorak suv ombori Qashqadaryo viloyatining to‘rt tumani uchun sug‘orish va energetika ta’minotida muhim rol o‘ynaydi, shu bilan birga atrof muhitga bir qator ta’sirlar ko‘rsatadi. Ochiq manbalar asosida bajarilgan tahlil quyidagilarni ko‘rsatdi: (1) Hisorak yuzasidan yillik bug‘lanish 1221 mm bo‘lib, tekislikdagi Talimarjondan taxminan 22 foiz kam; eng yuqori sathda hajmiy yo‘qotish loyihaviy hajmning taxminan 4 foizini tashkil etadi; (2) Oqsuv daryosining muzliklardan to‘yinishi tufayli Hisorakka keluvchi oqim yomg‘irdan to‘yinadigan daryolarga nisbatan barqaror, biroq bu ustunlik muzliklar zahirasiga bog‘liq; (3) viloyat daryolarida oqiziqlar konsentratsiyasining ortishi suv omborlarining loyqalanish xavfini oshiradi; (4) sizot suvlari, sho‘rlanish va biotaga ta’sir bo‘yicha Hisorakka xos dala ma’lumotlari yetarli emas, shuning uchun bu yo‘nalishlarda maxsus monitoring zarur; (5) to‘g‘on xavfsizligi va axborot ochiqligi ekologik xavfsizlikning ajralmas qismidir.

Kelgusi tadqiqotlar Hisorak uchun batimetriya, suv sifati, sizot suvlari va biotaning dala kuzatuvlari, shuningdek, tabiiy-geografik (GAT va DEM) tahlillarni o‘z ichiga olishi lozim.

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AN INTEGRATED MECHANISM FOR ENSURING ENTERPRISE FINANCIAL STABILITY UNDER GLOBAL ECONOMIC UNCERTAINTY

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Abstract. *This paper examines enterprise financial stability under global economic uncertainty. Drawing on a comparative analysis of international standards and methodological sources, it proposes a conceptual mechanism integrating risk assessment, cash flow planning, liquidity reserve management, and cross-functional coordination. The mechanism's stages, responsibilities, and performance indicators are outlined. Its interdisciplinary approach combines financial analysis, operational planning, and organizational management. The proposed mechanism requires empirical validation using enterprise-level data.*

Keywords: *economic uncertainty, financial stability, financial risk, integrated mechanism, cash flow, liquidity reserve.*

Annotatsiya. *Tezisda global iqtisodiy noaniqlik sharoitida korxonalarning moliyaviy barqarorligini ta'minlash masalalari o'rganilgan. Xalqaro standartlar va uslubiy manbalarni qiyosiy tahlil qilish asosida risklarni baholash, pul oqimlarini rejalashtirish, likvidlik zaxirasini boshqarish va bo'linmalararo hamkorlikni birlashtiruvchi konseptual mexanizm taklif etilgan. Uning bosqichlari, mas'ul ijrochilari va natijadorlik ko'rsatkichlari tizimlashtirilgan. Fanlararo yondashuv moliyaviy tahlil, operatsion rejalashtirish va tashkiliy boshqaruvni uyg'unlashtirish orqali ifodalangan. Taklif etilgan mexanizmni korxonalarning haqiqiy ma'lumotlari asosida empirik tekshirish zarurligi qayd etilgan.*

Kalit so'zlar: *iqtisodiy noaniqlik, moliyaviy barqarorlik, moliyaviy risk, integratsiyalashgan mexanizm, pul oqimi, likvidlik zaxirasi.*

Аннотация. *В тезисах рассматривается обеспечение финансовой устойчивости предприятий в условиях глобальной экономической неопределённости. На основе сравнительного анализа международных стандартов и методических источников предложен концептуальный механизм, объединяющий оценку рисков, планирование денежных потоков, управление резервом ликвидности и межфункциональное взаимодействие. Систематизированы его этапы, ответственные исполнители и показатели*

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результативности. Междисциплинарный подход выражен в согласовании финансового анализа, операционного планирования и организационного управления. Отмечена необходимость эмпирической проверки механизма на фактических данных предприятий.

Ключевые слова: *экономическая неопределённость, финансовая устойчивость, финансовый риск, интегрированный механизм, денежный поток, резерв ликвидности.*

Introduction

Global economic uncertainty underscores the need to align enterprise financial decisions with changing external conditions. The International Monetary Fund's April 2025 report highlights the importance of rebuilding buffers and adapting to risks amid policy shifts and heightened uncertainty. This macroeconomic context provides a basis for examining adaptive approaches to financial management at the enterprise level.

In this study, financial stability is understood as an enterprise's capacity to meet its obligations, finance its core operations, and preserve opportunities for development. The central research problem concerns the integration of risk assessment, cash flow planning, and operational decisions into a coherent management process.

The study aims to develop an integrated mechanism for ensuring enterprise financial stability under global economic uncertainty. Its objectives are to identify the mechanism's management components, establish their interrelationships, and propose performance assessment criteria.

Research Methods

The study employs comparative analysis of international standards and methodological publications, synthesis, a systems approach, and conceptual modelling. Sources were selected to address risk management, cash flows, early-warning indicators, and corporate governance.

The analysis comprised three stages: examining methodological requirements; linking factors affecting financial stability to management tasks; and developing an integrated mechanism and assessment criteria. As no primary enterprise data were used, the findings are presented as conceptual proposals.

Research Results

Methodological Foundations

ISO 31000:2018 treats risk identification, analysis, evaluation, treatment, and monitoring as interrelated processes. COSO guidance emphasizes linking early-warning indicators to underlying risk drivers and management actions.

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Cash flow assessment can draw on the classification of operating, investing, and financing activities established by IAS 7. Accordingly, the proposed mechanism separately plans funds generated by core operations, investment payments, and debt-related cash flows.

From a corporate governance perspective, the G20/OECD Principles address sustainability and resilience as a distinct area. The mechanism therefore encompasses not only financial indicators but also decision-making responsibilities and cross-functional coordination.

Structure of the Integrated Mechanism

The proposed mechanism follows this sequence:

External change → assessment of financial impact → cash flow planning → response measures → reassessment of results.

An external factor is thus linked to a management decision through its assessed effect on the enterprise's receipts, expenditures, or obligations.

Table 1

Integrated Mechanism for Ensuring Enterprise Financial Stability

Stage	Main task	Responsible units	Management output
Risk identification	Monitor demand, costs, exchange rates, and financing conditions	Finance, sales, and procurement departments	Prioritized risk register
Financial impact assessment	Assess effects on receipts, payments, and debt servicing	Finance department and relevant specialists	Estimated funding shortfall
Resource coordination	Align payments, purchases, and investment schedules	Finance, production, and procurement departments	Updated cash flow plan
Selection of responses	Assess options for accelerating receipts, revising expenditure, and obtaining financing	Enterprise management	Approved action plan
Monitoring and adjustment	Compare planned and actual results	Finance department and designated staff	Revised decisions

For example, when the cost of imported raw materials is expected to increase, the procurement department provides information on purchasing terms. The production department assesses inventories and production schedules, while the sales department evaluates possible adjustments to prices or sales terms. The finance department consolidates the cash flow implications of these alternatives. The final decision considers not only purchase prices but also operational continuity and financing capacity.

Liquidity Reserves and Decision-Making Procedures

The mechanism proposes setting a minimum liquidity reserve based on mandatory payments, the stability of cash receipts, and access to financing. It does not prescribe a uniform reserve requirement for all enterprises.

Where cash flow projections indicate that the reserve may be insufficient, the following options are assessed sequentially:

- collecting receivables and accelerating cash receipts;
- negotiating payment schedules with counterparties;
- rescheduling expenditure and investments that can be deferred;
- evaluating the costs and terms of additional financing.

Each measure is assigned a responsible person, an implementation deadline, and an expected financial outcome. Expenditure reductions are assessed alongside constraints relating to occupational safety, product quality, and mandatory payments.

Discussion

The principal feature of the proposed mechanism is not the enumeration of individual financial instruments but their integration into a unified decision-making process. Risk information informs the cash flow plan, which subsequently determines departmental tasks and management decisions.

The interdisciplinary dimension combines financial analysis, operational planning, and organizational management. In this way, global uncertainty is connected to practical enterprise-level tasks: coordinating payments, determining liquidity reserves, and selecting response measures.

The mechanism may be evaluated using the following indicators:

- cash flow forecast error;
- the proportion of mandatory payments made after their due dates;
- the number of periods involving liquidity shortfalls;
- the implementation rate of approved response measures;
- the cost of funds raised through emergency financing.

Comparisons with the pre-implementation period should account for differences in sales volumes, seasonality, and external conditions. The principal limitations concern data quality, forecasting assumptions, and cross-functional coordination. Initial implementation within a limited operational area is therefore recommended.

Conclusion

The study proposes a conceptual mechanism integrating risk assessment, cash flow planning, liquidity reserve management, and cross-functional coordination. Its practical focus is to connect external changes with specific financial impacts and corresponding management responses.

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Implementation requires clear information-sharing procedures, defined responsibilities, and regular reassessment of results. The effectiveness of the proposed approach should be empirically tested using actual enterprise data.

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ВЛИЯНИЕ ОРГАНОМИНЕРАЛЬНЫХ УДОБРЕНИЙ И ПРЕПАРАТОВ-РЕГУЛЯТОРОВ РОСТА НА ПРОДОЛЖИТЕЛЬНОСТЬ ФАЗ РАЗВИТИЯ И СОХРАННОСТЬ РАСТЕНИЙ СОРТОВ КАРТОФЕЛЯ

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Аннотация. *В статье представлены данные о влиянии выращивания сортов картофеля Arizona и Evolution в условиях Хорезмской области при применении различных норм органоминеральных удобрений и внекорневой подкормке препаратами, регулирующими рост, на продолжительность фаз развития растений и количество сохранившихся растений перед уборкой урожая.*

Abstract. *This article presents data on the effect of growing the Arizona and Evolution potato varieties under the conditions of the Khorezm region using different rates of organic and mineral fertilizers and foliar application of growth-regulating preparations on the duration of developmental phases and the number of surviving plants before harvest.*

Ключевые слова: *рост, развитие, органоминеральное удобрение, регулятор роста растений, внекорневая подкормка, продолжительность фаз развития, количество сохранившихся растений перед уборкой урожая.*

Keywords: *growth, development, organomineral fertilizer, plant growth regulator, foliar feeding, duration of developmental phases, number of surviving plants before harvest.*

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Введение. Рост и развитие картофеля *(Solanum tuberosum L.)* зависят от биологических особенностей сорта и условий выращивания, при этом продолжительность фаз развития является одним из важных показателей процесса формирования урожая [7,9]. Сроки наступления фаз всходов, бутонизации, цветения и созревания могут изменяться в зависимости от уровня обеспеченности растений питательными веществами[4,8]. Применение

органических и минеральных удобрений в различных нормах формирует режим питания растений, тогда как внекорневая подкормка препаратами-регуляторами роста оказывает влияние на интенсивность физиологических процессов. Совместное воздействие данных факторов может по-разному проявляться в сроках наступления и продолжительности отдельных фаз развития сортов картофеля [7,10].

В связи с этим определение продолжительности фаз развития при выращивании сортов картофеля с применением различных норм органических и минеральных удобрений, а также внекорневой подкормки препаратами-регуляторами роста имеет важное научное и практическое значение. Цель исследования - оценить влияние указанных агротехнических факторов на продолжительность фаз развития сортов картофеля.

Материалы и методы исследования. Исследования проводили в условиях староорошаемых лугово-аллювиальных почв Хорезмской области. Изучали влияние различных норм органоминеральных удобрений ($N_{200}P_{140}K_{100}$ (к-л); $N_{200}P_{140}K_{100}$ + 20 т/га навоза крупного рогатого скота; $N_{200}P_{140}K_{100}$ + 16 т/га навоза крупного рогатого скота + 4 т/га птичьего помёта; $N_{200}P_{140}K_{100}$ + 12 т/га навоза крупного рогатого скота + 8 т/га птичьего помёта; $N_{200}P_{140}K_{100}$ + 8 т/га навоза крупного рогатого скота + 12 т/га птичьего помёта), а также внекорневой подкормки препаратами-регуляторами роста в период вегетации (без обработки (контроль); Джи-Джана Плюс - 150 г/га; Микромикс - 150 г/га) на продолжительность фаз развития и количество сохранившихся растений перед уборкой урожая у сортов картофеля Аризона и Эволюшн. Опыт проводили в четырёхкратной повторности. Площадь одной делянки составляла 70 м² [1, 2, 3, 5].

Результаты исследования. В наших исследованиях посадку сортов картофеля проводили 5-7 марта, а уборку урожая - 1-3 июля. В контрольном варианте, где применяли минеральные удобрения в норме $N_{200}P_{140}K_{100}$, появление всходов у сортов Arizona и Evolution наблюдалось 29 марта - 1 апреля. Фаза бутонизации отмечалась с 30 апреля по 3 мая, цветение - 6-9 мая, пожелтение ботвы - 18-21 июня. В вариантах с применением препаратов-регуляторов роста «Джи-Джана Плюс» (150 г/га) и «Микромикс» (150 г/га) на фоне контрольного варианта по органоминеральному удобрению у обоих сортов фаза бутонизации наблюдалась 30 апреля - 4 мая, цветение - 7-11 мая, пожелтение ботвы - 19-24 июня. Установлено, что под влиянием указанных препаратов продолжительность периода развития растений несколько увеличивалась. При выращивании сортов картофеля на фоне внесения $N_{200}P_{140}K_{100}$ + 20 т/га навоза крупного рогатого скота и без обработки

препаратами-регуляторами роста (контрольный вариант) появление всходов наблюдалось 28-31 марта, бутонизация - 29 апреля - 2 мая, цветение – 5-9 мая, пожелтение ботвы - 17-21 июня. В вариантах с внекорневой подкормкой препаратами «Джи-Джана Плюс» (150 г/га) и «Микромикс» (150 г/га) бутонизация отмечалась 30 апреля - 3 мая, цветение - 7-11 мая, пожелтение ботвы - 19-24 июня. При внесении органоминеральных удобрений в норме $N_{200}P_{140}K_{100}$ + 16 т/га навоза крупного рогатого скота + 4 т/га птичьего помёта в контрольном варианте без применения регуляторов роста появление всходов наблюдалось 28–31 марта, бутонизация - 30 апреля -3 мая, цветение - 7-10 мая, пожелтение ботвы - 19-23 июня. При внекорневой подкормке препаратами «Джи-Джана Плюс» (150 г/га) и «Микромикс» (150 г/га) бутонизация отмечалась 30 апреля - 4 мая, цветение - 7-12 мая, пожелтение ботвы - 20-29 июня. При внесении $N_{200}P_{140}K_{100}$ + 12 т/га навоза крупного рогатого скота + 8 т/га птичьего помёта в контрольном варианте без обработки регуляторами роста появление всходов наблюдалось 28-31 марта, бутонизация - 30 апреля - 5 мая, цветение - 7-10 мая, пожелтение ботвы - 19-23 июня. В вариантах с внекорневой подкормкой препаратами «Джи-Джана Плюс» (150 г/га) и «Микромикс» (150 г/га) у обоих сортов бутонизация отмечалась 1-4 мая, цветение - 8-12 мая, пожелтение ботвы - 22-29 июня. При внесении органоминеральных удобрений в норме $N_{200}P_{140}K_{100}$ + 8 т/га навоза крупного рогатого скота + 12 т/га птичьего помёта в контрольном варианте без применения регуляторов роста появление всходов наблюдалось 28-31 марта, бутонизация - 30 апреля - 3 мая, цветение - 7-10 мая, пожелтение ботвы – 19-24 июня. При внекорневой подкормке препаратами «Джи-Джана Плюс» (150 г/га) и «Микромикс» (150 г/га) у обоих сортов бутонизация отмечалась 1-4 мая, цветение - 8-12 мая, пожелтение ботвы - 21-29 июня. Результаты исследований показали, что под влиянием органических удобрений и препаратов-регуляторов роста у обоих сортов картофеля продолжительность отдельных фаз развития растений увеличивалась на 1-5 дней.

У сортов картофеля в контрольном варианте, где применяли минеральные удобрения в норме $N_{200}P_{140}K_{100}$ без обработки препаратами-регуляторами роста, продолжительность периода от появления всходов до пожелтения ботвы в среднем за годы исследований составляла 81 день. При применении препарата «Джи-Джана Плюс» этот показатель увеличивался до 83-84 дней, а при использовании препарата «Микромикс» - до 82 дней.

При внесении $N_{200}P_{140}K_{100}$ + 20 т/га навоза крупного рогатого скота продолжительность периода до пожелтения ботвы была несколько выше. В контрольном варианте (без обработки препаратами) она составляла в среднем

81–82 дня, при применении «Джи-Джана Плюс» - 84-85 дней, а при использовании «Микромикс» - 83 дня. При внесении $N_{200}P_{140}K_{100}$ + 16 т/га навоза крупного рогатого скота + 4 т/га птичьего помёта продолжительность периода до пожелтения ботвы увеличивалась. В контрольном варианте среднее значение по годам составляло 83–84 дня, при применении «Джи-Джана Плюс» - 84-88 дней, а при использовании препарата «Микромикс» - 84-85 дней. На фоне внесения $N_{200}P_{140}K_{100}$ + 12 т/га навоза крупного рогатого скота + 8 т/га птичьего помёта продолжительность периода до пожелтения ботвы составляла 83-84 дня в контрольном варианте, 86-90 дней при применении «Джи-Джана Плюс» и 84-87 дней при использовании «Микромикс». При внесении органоминеральных удобрений в норме $N_{200}P_{140}K_{100}$ + 8 т/га навоза крупного рогатого скота + 12 т/га птичьего помёта, но без обработки препаратами-регуляторами роста (контроль), продолжительность периода до пожелтения ботвы составляла 83-85 дней. При применении «Джи-Джана Плюс» этот показатель достигал 87-90 дней, а при использовании «Микромикс» - 85-88 дней. В контрольном варианте, где сорта картофеля выращивали с применением минеральных удобрений в норме $N_{200}P_{140}K_{100}$ без обработки препаратами-регуляторами роста, количество сохранившихся растений перед уборкой урожая в среднем за годы исследований составляло 64,9-65,4 тыс. шт./га. При применении препарата «Джи-Джана Плюс» данный показатель увеличивался до 66,1-66,7 тыс. шт./га, а при использовании препарата «Микромикс» - до 65,2-65,7 тыс. шт./га.

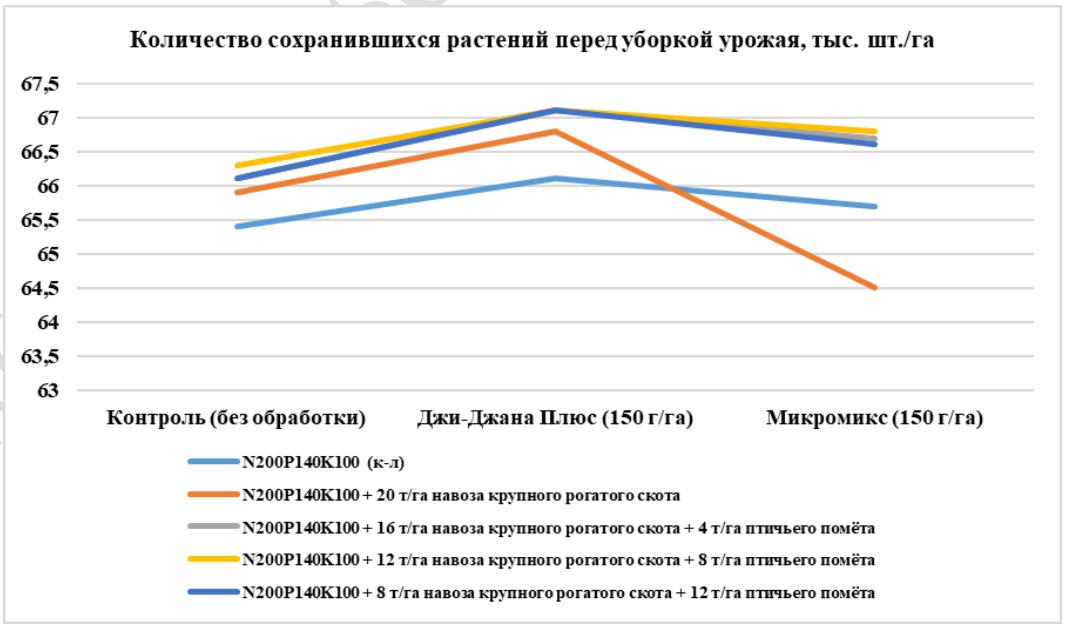

Рисунок 1. Количество сохранившихся растений перед уборкой урожая при выращивании сортов картофеля с применением различных норм органических и минеральных удобрений и препаратов-регуляторов роста (схема посадки 70 × 20 см, 2024–2026 гг.)

При внесении $N_{200}P_{140}K_{100}$ + 20 т/га навоза крупного рогатого скота сохранность растений картофеля была несколько выше. В контрольном варианте (без обработки препаратами-регуляторами роста) количество сохранившихся растений перед уборкой урожая в среднем составляло 65,5-65,9 тыс. шт./га, при применении препарата «Джи-Джана Плюс» - 66,3-66,8 тыс. шт./га, а при использовании препарата «Микромикс» - 64,5-65,9 тыс. шт./га. Установлено, что на фоне внесения $N_{200}P_{140}K_{100}$ + 16 т/га навоза крупного рогатого скота + 4 т/га птичьего помёта количество сохранившихся растений перед уборкой урожая у сортов картофеля Arizona и Evolution увеличивалось. В контрольном варианте среднее значение по годам составляло 65,7-66,1 тыс. шт./га, при применении препарата «Джи-Джана Плюс» - 66,6-67,1 тыс. шт./га, а при использовании препарата «Микромикс» - 66,1-66,7 тыс. шт./га. В варианте с внесением органоминеральных удобрений в норме $N_{200}P_{140}K_{100}$ + 12 т/га навоза крупного рогатого скота + 8 т/га птичьего помёта количество сохранившихся растений перед уборкой урожая составляло 65,9-66,3 тыс. шт./га в контрольном варианте, 66,6-67,1 тыс. шт./га при применении препарата «Джи-Джана Плюс» и 66,2-66,8 тыс. шт./га при использовании препарата «Микромикс». При внесении $N_{200}P_{140}K_{100}$ + 8 т/га навоза крупного рогатого скота + 12 т/га птичьего помёта без обработки препаратами-регуляторами роста (контроль) количество сохранившихся растений перед уборкой урожая составляло 65,9-66,1 тыс. шт./га. При применении препарата «Джи-Джана Плюс» данный показатель достигал 66,6-67,1 тыс. шт./га, а при использовании препарата «Микромикс» - 66,1-66,6 тыс. шт./га.

Заключение. В условиях староорошаемых лугово-аллювиальных почв Хорезмской области при выращивании в основном посеве среднеранних сортов картофеля Arizona и Evolution на фоне внесения органоминеральных удобрений в норме $N_{200}P_{140}K_{100}$ + 12 т/га навоза крупного рогатого скота + 8 т/га птичьего помёта и двукратной внекорневой подкормки в период вегетации препаратом-регулятором роста «Джи-Джана Плюс» (150 г/га) прорастание семенных клубней наступало через 23-24 дня. Продолжительность вегетационного периода составляла 86-90 дней, увеличиваясь на 3-6 дней, а

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количество сохранившихся растений перед уборкой урожая достигало 66,6-67,1 тыс. шт./га, что соответствовало 93,7-94,1 % от первоначального количества растений.

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ПОЛУЧЕНИЕ КАРБОКСИМЕТИЛЦЕЛЛЮЛОЗЫ ИЗ ОТХОДОВ ХЛОПЧАТНИКА И ЕЁ ПРИМЕНЕНИЕ В ПРОИЗВОДСТВЕ БИОРАЗЛАГАЕМЫХ УПАКОВОЧНЫХ МАТЕРИАЛОВ

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Аннотация. *В работе рассматриваются технологические подходы к получению карбоксиметилцеллюлозы (КМЦ) из отходов хлопчатника и возможности её применения при создании биоразлагаемых упаковочных материалов. Описаны основные стадии подготовки растительного сырья, выделения целлюлозы, её химической модификации и формирования полимерных плёнок. На основе анализа научных публикаций показано, что хлопковые стебли и отходы хлопкоочистительной промышленности могут служить источником целлюлозы для синтеза КМЦ. Отдельное внимание уделено преимуществам и ограничениям КМЦ-плёнок, а также способам улучшения их механических и барьерных свойств.*

Ключевые слова: *отходы хлопчатника, карбоксиметилцеллюлоза, химическая модификация, биоразлагаемая упаковка, полимерные плёнки, зелёная химия.*

Abstract. *The paper considers technological approaches to obtaining carboxymethylcellulose (CMC) from cotton plant waste and the possibilities of its application in the production of biodegradable packaging materials. The main stages of plant raw material preparation, cellulose isolation, its chemical modification and formation of polymer films are described. Based on the analysis of scientific publications, it is shown that cotton stalks and cotton ginning industry waste can serve as a source of cellulose for CMC synthesis. Special attention is paid to the advantages and limitations of CMC films, as well as to methods for improving their mechanical and barrier properties.*

Keywords: *cotton plant waste, cellulose, carboxymethylcellulose, chemical modification, biodegradable packaging, polymer films, green chemistry.*

Annotatsiya. *Ishda paxta o‘simligi chiqindilaridan karboksimetiltsellyuloza (KMTs) olish texnologik yondashuvlari va uni biologik parchalanadigan qadoqlash materiallarini yaratishda qo‘llash imkoniyatlari ko‘rib chiqiladi. O‘simlik xom*

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ashyosini tayyorlash, tsellyulozani ajratib olish, uni kimyoviy modifikatsiya qilish va polimer plyonkalarini shakllantirishning asosiy bosqichlari tavsiflangan. Ilmiy nashrlar tahlili asosida paxta poyalari va paxta tozalash sanoati chiqindilari KMTs sintez qilish uchun tsellyuloza manbai bo‘lib xizmat qilishi mumkinligi ko‘rsatilgan. KMTs plyonkalarining afzalliklari va cheklovlari, shuningdek, ularning mexanik va to‘siq xususiyatlarini yaxshilash usullariga alohida e’tibor qaratilgan.

Kalit so‘zlar: *paxta chiqindilari, tsellyuloza, karboksimetiltsellyuloza, kimyoviy modifikatsiya, biologik parchalanadigan qadoq, polimer plyonkalar, yashil kimyo.*

ВВЕДЕНИЕ

Одной из актуальных задач современной химической технологии является разработка материалов, способных уменьшить зависимость упаковочной промышленности от полимеров нефтехимического происхождения. Значительная часть традиционной пластиковой упаковки сохраняется в окружающей среде длительное время и при ненадлежащем обращении становится источником загрязнения почвы и водных объектов. Поэтому возрастает интерес к материалам на основе возобновляемого растительного сырья, в том числе к целлюлозным и другим биополимерным композициям.

Для Узбекистана данное направление имеет особое значение благодаря развитому хлопководству и наличию побочных продуктов переработки хлопчатника. Стебли хлопчатника, волокнистые остатки и отходы хлопкоочистительных предприятий содержат целлюлозу, которую можно использовать не только для получения традиционных целлюлозных материалов, но и как сырьё для химической модификации. Одним из перспективных продуктов такой переработки является карбоксиметилцеллюлоза — водорастворимое производное целлюлозы, обладающее загущающими, стабилизирующими и плёнкообразующими свойствами.

Цель работы — проанализировать технологические возможности получения карбоксиметилцеллюлозы из отходов хлопчатника и оценить перспективы её применения в составе биоразлагаемых упаковочных материалов.

Материалы и методы

Работа носит обзорно-аналитический характер. Проведён анализ научных публикаций, посвящённых выделению целлюлозы из стеблей хлопчатника и отходов хлопкоочистительной промышленности, синтезу натриевой

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карбоксиметилцеллюлозы, а также разработке плёночных материалов на основе КМЦ. Рассмотрены общие технологические стадии: механическая подготовка сырья, удаление сопутствующих компонентов, щелочная обработка целлюлозосодержащей массы, карбоксиметилирование, очистка продукта и формирование плёнок методом полива с последующей сушкой. Экспериментальные результаты в настоящей работе не получали; количественные показатели приводятся по опубликованным исследованиям.

РЕЗУЛЬТАТЫ И ОБСУЖДЕНИЕ

Получение КМЦ из отходов хлопчатника включает несколько последовательных этапов. На первой стадии сырьё сортируют, очищают от земли и посторонних включений, высушивают и измельчают. Затем проводят химическую обработку, направленную на удаление восков, пектиновых веществ, гемицеллюлоз и части лигнина. Для выделения целлюлозы обычно применяют щелочную обработку; при необходимости её дополняют стадиями отбеливания и промывки. Режимы обработки должны подбираться с учётом состава конкретного вида отходов, поскольку избыточно жёсткие условия могут приводить к снижению степени полимеризации целлюлозы.

Следующая стадия — карбоксиметилирование. Целлюлозу обрабатывают раствором гидроксида натрия, в результате чего формируется щелочная целлюлоза с повышенной реакционной способностью. Затем вводят монохлорацетат натрия или монохлоруксусную кислоту в соответствующей технологической системе. В ходе реакции часть гидроксильных групп целлюлозы замещается карбоксиметильными группами, и образуется карбоксиметилцеллюлоза. После завершения реакции продукт отделяют от реакционной среды, промывают для удаления солей и побочных компонентов, нейтрализуют при необходимости, высушивают и измельчают.

Качество полученной КМЦ оценивают по степени замещения, вязкости раствора, растворимости, чистоте и молекулярно-массовым характеристикам. Эти показатели определяют способность полимера образовывать однородные растворы и плёнки, а также влияют на прочность и функциональные свойства готовой упаковки. В исследовании G. Zhang и соавторов показана возможность получения натриевой КМЦ непосредственно из стеблей хлопчатника с применением микроволнового нагрева. Авторы сообщили о выходе целлюлозы 87,52%; для полученного продукта степень замещения составила 0,77, вязкость — 498 мПа·с, а чистота — 92% [1]. Эти данные подтверждают принципиальную возможность использования хлопковых стеблей как сырья для получения КМЦ.

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Другой пример представлен в работе N. Haleem и соавторов, где целлюлозу выделяли из отходов хлопкоочистительной промышленности, а затем подвергали этерификации с использованием монохлоруксусной кислоты. В исследовании изучалось влияние концентрации гидроксида натрия и других параметров процесса; при выбранных авторами оптимальных условиях степень замещения КМЦ достигала 0,874 [2]. Результаты этих работ нельзя напрямую переносить на любое хлопковое сырьё: состав отходов и технологические условия влияют на выход и свойства конечного продукта. Однако они демонстрируют наличие научной и технологической основы для такой переработки.

Перспективное направление применения КМЦ — получение тонких упаковочных плёнок и защитных покрытий. Для этого готовят водный раствор полимера, при необходимости вводят пластификатор, например глицерин, а также другие природные полимеры. Смесь гомогенизируют, удаляют пузырьки воздуха, распределяют тонким слоем на формующей поверхности и высушивают. В качестве компонентов композиции могут использоваться крахмал, альгинат, хитозан или другие целлюлозные производные. Подбор состава позволяет регулировать эластичность, прочность, прозрачность и барьерные свойства материала.

Вместе с тем плёнки на основе чистой КМЦ обладают существенным ограничением — высокой чувствительностью к влаге, поскольку карбоксиметильные группы придают полимеру гидрофильность. Это может приводить к набуханию, снижению прочности и ухудшению защитных свойств при контакте с водой или водяным паром. В обзорной публикации P. Kasle и соавторов отмечено, что смешивание КМЦ с крахмалом, альгинатом, хитозаном и другими полимерными компонентами, а также применение наполнителей и методов сшивания может улучшать механические и водобарьерные характеристики плёнок [3]. Поэтому для упаковочного применения необходимо подбирать состав композиции с учётом назначения продукта и условий его хранения.

При оценке экологических преимуществ важно различать биологическое происхождение сырья и фактическую биоразлагаемость готового изделия. Наличие КМЦ в составе само по себе не гарантирует быстрого разложения упаковки в любых условиях: на этот процесс влияют добавки, сшивающие агенты, толщина плёнки, влажность, температура и активность микроорганизмов. Следовательно, перспективные композиции должны проходить испытания на механическую прочность, водопоглощение,

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паропроницаемость и биоразложение в условиях, соответствующих предполагаемому способу утилизации.

Таким образом, переработка хлопковых отходов в КМЦ может объединить две важные задачи: повышение степени использования сельскохозяйственного сырья и получение функционального полимера для экологически ориентированных материалов. Дополнительный интерес представляет локальная организация такого производства, поскольку использование доступного растительного сырья потенциально позволяет создавать продукцию с добавленной стоимостью и развивать ресурсосберегающие технологии.

ВЫВОДЫ

Анализ научных публикаций показывает, что отходы хлопчатника и хлопкоочистительной промышленности могут служить сырьевой основой для выделения целлюлозы и последующего получения карбоксиметилцеллюлозы. Основными стадиями процесса являются подготовка и очистка растительного сырья, выделение целлюлозы, её щелочная активация, карбоксиметилирование и очистка готового продукта. КМЦ обладает плёнкообразующими свойствами и может использоваться для создания биоразлагаемых упаковочных композиций.

Для повышения эксплуатационных характеристик таких материалов целесообразно исследовать сочетание КМЦ с крахмалом, альгинатом и хитозаном, а также влияние пластификаторов и методов модификации на прочность и влагостойкость плёнок. Дальнейшие исследования должны включать оптимизацию технологических параметров и экспериментальную оценку биоразлагаемости готовых изделий. Практическая реализация данного направления может способствовать более рациональному использованию отходов хлопководства и развитию экологически ориентированной химической технологии в Узбекистане.

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8. ⚖ SOCIAL SCIENCES, HUMANITIES AND LAW: SOCIETAL DEVELOPMENT, RESEARCH COOPERATION AND INTERNATIONAL RELATIONS.

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СУНЪИЙ ИНТЕЛЛЕКТНИНГ КИБЕРЖИНОЯТЧИЛИК ВА ОНЛАЙН РАДИКАЛЛАШУВГА ТАЪСИРИ: РАҚАМЛИ ХАВФЛАРНИНГ ОЛДИНИ ОЛИШ ЙЎНАЛИШЛАРИ

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Аннотация. *Мақолада сунъий интеллект ёрдамида содир этиладиган кибержиноятларнинг асосий хусусиятлари ва мазкур технологияларнинг онлайн радикаллашув жараёнларига эҳтимолий таъсири таҳлил қилинган. UNODC ҳамда БМТ Хавфсизлик Кенгаши материаллари асосида рақамли муҳитдаги хавфлар таснифланиб, профилактика, рақамли далилларни текшириш ва идоралараро ҳамкорликни такомиллаштириш йўналишлари асосланган.*

Калит сўзлар: *сунъий интеллект, кибержиноятчилик, онлайн радикаллашув, дипфейк, террористик тарғибот, рақамли профилактика.*

Аннотация. *В тезисе рассмотрены основные особенности киберпреступлений с применением искусственного интеллекта и потенциальное влияние таких технологий на онлайн-радикализацию. На основе материалов УНП ООН и Контртеррористического комитета Совета Безопасности ООН систематизированы цифровые риски и предложены направления совершенствования профилактики, проверки электронных доказательств и межведомственного взаимодействия.*

Ключевые слова: *искусственный интеллект, киберпреступность, онлайн-радикализация, дипфейк, террористическая пропаганда, цифровая профилактика.*

Abstract. *This thesis examines the main characteristics of AI-enabled cybercrime and the potential impact of such technologies on online radicalization. Drawing on UNODC and United Nations Security Council counter-terrorism materials, it identifies key digital risks and proposes approaches to prevention, verification of digital evidence, and inter-agency cooperation.*

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Keywords: *artificial intelligence, cybercrime, online radicalization, deepfake, terrorist propaganda, digital prevention.*

Кириш. Рақамли технологиялар ҳаётнинг барча соҳаларига жорий этилаётган шароитда сунъий интеллект (СИ) воситаларидан жиноий мақсадларда фойдаланиш киберхавфсизликнинг долзарб муаммоларидан бирига айланмоқда. БМТнинг Гиёҳвандлик ва жиноятчилик бўйича бошқармаси (UNODC) 2026 йил 2 ноябрда эълон қилган материалда СИ кибержиноятларни содир этиш учун зарур техник тўсиқларни пасайтириб, уларнинг кўлами ва ишонарлилигини ошираётгани таъкидланган [1]. Мазкур жараённинг аҳамияти фақат ахборот тизимларига тажовуз қилиш билан чекланмасдан, инсон ишончи ва ахборотни қабул қилиш механизмларига таъсир ўтказиш имкониятлари кенгаяётганида намоён бўлмоқда.

Асосий қисм. UNODC таҳлилларига кўра, СИ ёрдамида ишонарли фишинг хабарлари, қалбаки тасвир, овоз ва видеолар тайёрлаш, ижтимоий муҳандислик усулларини автоматлаштириш ҳамда ахборот тизимларига нисбатан киберҳужумларни қўллаб-қувватлаш мумкин [1]. Натижада жиноий фаолиятда алдашнинг техник ва психологик воситалари бирлашиб, фойдаланувчи учун ҳақиқий ва сунъий яратилган ахборотни фарқлаш қийинлашади.

Ушбу ўзгаришлар терроризм ва экстремизмга қарши курашиш йўналиши учун ҳам аҳамиятлидир. БМТ Хавфсизлик Кенгаши Терроризмга қарши курашиш қўмитаси Ижроия дирекциясининг 2026 йил 10 сентябрдаги ҳисоботида террористик тарғибот энди фақат ахборот тарқатиш воситаси эмас, балки ёллаш, радикаллаштириш, молиялаштириш ва ташкилий алоқаларни қўллаб-қувватловчи фаолият элементи сифатида баҳоланган. Ҳисоботда террористик субъектлар СИдан кўп тилли контент тайёрлаш, хабарларни муайян аудиторияга мослаштириш ва тарафдорлар билан мулоқот имкониятларини кенгайтиришда фойдаланаётгани қайд этилган [2].

Шу нуқтаи назардан, кибержиноятчиликда кузатилаётган дипфейк, сохта шахсий аккаунт ва автоматлаштирилган мулоқот каби усуллар онлайн радикаллашув учун ҳам қўшимча имконият яратиши мумкин. Бироқ материалнинг ҳуқуқий баҳоси унинг мазмуни, мақсади ва текширилган далилларга таяниши лозим.

Тадқиқот доирасида мазкур хавфларни уч ўзаро боғлиқ йўналишда баҳолаш мақсадга мувофиқ деб ҳисобланади. Биринчиси — ахборотнинг ҳаққонийлигига таҳдид бўлиб, дипфейк ва синтетик материаллар манбага бўлган ишончни суиистеъмол қилади. Иккинчиси — коммуникацион хавф,

яъни автоматлаштирилган мулоқот ва аудиторияга мослаштирилган хабарлар воситасида манипулятив таъсирнинг кучайишидир. Учинчиси — тергов-далилий хавф бўлиб, рақамли изларнинг турли платформалар ва давлатлар юрисдикцияларида тарқалиши электрон далилларни ўз вақтида олиш ҳамда асллигини текширишни мураккаблаштиради.

Мазкур хавфларга жавоб чоралари ҳам комплекс ёндашувга асосланиши зарур. UNODC киберхавфсизликнинг техник воситалари — тизимларга киришни назорат қилиш, заифликларни баҳолаш ва таҳдидлар мониторингини — аҳолининг рақамли саводхонлигини ошириш, шубҳали ҳолатлар ҳақида хабар бериш ва жабрланувчиларга ёрдам кўрсатиш чоралари билан биргаликда қўллашни тавсия этади [1]. Бу ёндашув онлайн радикаллашув профилактикасида ҳам рақамли контентни аниқлаш билан чекланмай, унинг аудиторияга таъсири ва тарқалиш муҳитини ўрганиш зарурлигини кўрсатади.

Шу билан бирга, СИ хавф манбаи бўлиш билан бир қаторда, профилактика ва таҳлил учун ҳам амалий имкониятлар яратади. Хусусан, катта ҳажмдаги очиқ маълумотлардан такрорланувчи манипулятив белгиларни ажратиш, сунъий яратилган медиаматериалларни дастлабки техник баҳолаш ва шубҳали рақамли фаолликни саралашда ушбу технологиялардан фойдаланиш мумкин. Бироқ автоматик классификация натижаларини мустақил далил сифатида қабул қилмасдан, мутахассис текшируви, контекстуал таҳлил ва шахс ҳуқуқларини ҳимоя қилиш кафолатларини таъминлаш шарт.

Халқаро ҳамкорликнинг аҳамияти БМТ Бош Ассамблеясининг 2024 йил 24 декабрдаги 79/243-сон резолюцияси билан қабул қилинган Кибержиноятчиликка қарши конвенциясида ҳам ўз аксини топган. Унинг 53-моддаси кибержиноятчилик профилактикасида давлат органлари, хусусий сектор, академик муассасалар ва фуқаролик жамияти ҳамкорлигини ривожлантиришни назарда тутади; конвенция электрон далилларни сақлаш ва алмашиш бўйича халқаро ҳамкорлик механизмларини ҳам белгилайди [3].

Ўзбекистон шароитида мазкур халқаро тажрибани инобатга олган ҳолда профилактик фаолиятда уч устувор вазифани ажратиш мумкин: ўзбек ва рус тилларидаги синтетик контентни аниқлаш бўйича мутахассислар малакасини ошириш; ёшлар ҳамда меҳнат мигрантлари учун манбани текшириш ва дипфейкни танишга қаратилган қисқа амалий ўқув материалларини тайёрлаш; кибержиноятчиликка ва терроризмга қарши курашиш йўналишлари ўртасида рақамли хавфлар ҳақидаги умумлаштирилган таҳлилий ахборот алмашинувини тизимлаштириш. Бунда аниқ шахсга нисбатан хулоса фақат қонунга мувофиқ олинган ва текширилган далилларга асосланиши керак.

Хулоса. Сунъий интеллект кибержиноятчиликда мавжуд усулларни тезлаштириб, уларнинг миқёси ва ишонарлилигини оширмоқда. Ушбу технологик имкониятлар онлайн радикаллашув ҳамда террористик тарғиботда ҳам суиистеъмол қилиниши мумкинлиги халқаро таҳлилларда қайд этилган. Шундан келиб чиқиб, рақамли хавфларни барвақт аниқлаш, контентнинг ҳаққонийлигини баҳолаш, аҳолининг медиасаводхонлигини ошириш ва халқаро электрон далиллар ҳамкорлигини ривожлантиришга асосланган уйғун профилактика тизимини такомиллаштириш мақсадга мувофиқ. Истиқболда ўзбек тилидаги синтетик контентни аниқлаш ва профилактик тадбирлар самарадорлигини эмпирик баҳолаш муҳимдир.

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NAVOIY VILOYATI BOSMA OMMAVIY AXBOROT VOSITALARINING YOSHLAR MA'NAVIY-AXLOQIY TARBIYASIDAGI O'RNI

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Annotatsiya. *Mazkur maqolada Navoiy viloyati bosma ommaviy axborot vositalarining yoshlar ma'naviy-axloqiy tarbiyasidagi o'rni tarixiy manbalar asosida tadqiq etiladi. "Do'stlik bayrog'i" va "Знамя дружбы" gazetalarining 1991-2025-yillarda chop etilgan ayrim sonlari misolida vatanparvarlik, milliy qadriyatlar, ta'lim, ma'rifat, kasb-hunarga yo'naltirish, jismoniy tarbiya va yoshlarning ijtimoiy faolligi masalalarining yoritilish xususiyatlari tahlil qilinadi. Shuningdek, hududiy matbuotning tarixiy xotirani saqlash, ijtimoiy qarashlarni shakllantirish va yosh avlodni ma'naviy qadriyatlar ruhida tarbiyalashga qaratilgan faoliyati yoritiladi.*

Kalit so'zlar: *Navoiy viloyati, bosma matbuot, yoshlar tarbiyasi, ma'naviy qadriyatlar, tarixiy xotira.*

Аннотация. *В данной статье на основе исторических источников исследуется роль печатных средств массовой информации Навоийской области в духовно-нравственном воспитании молодёжи. На примере отдельных номеров газет «Дустлик байроки» и «Знамя дружбы», опубликованных в 1991-2025 годах, анализируются особенности освещения вопросов патриотизма, национальных ценностей, образования, просвещения, профессиональной ориентации, физического воспитания и общественной активности молодёжи. Кроме того, рассматривается деятельность региональной прессы, направленная на сохранение исторической памяти,*

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формирование общественных взглядов и воспитание молодого поколения в духе духовно-нравственных ценностей.

***Ключевые слова**: Навоийская область, печатная пресса, воспитание молодёжи, духовные ценности, историческая память.*

***Abstract.** This article examines the role of print media in the Navoi region in the spiritual and moral education of young people based on historical sources. Drawing on selected issues of the newspapers Do‘stlik bayrog‘i and Znamya druzhby published between 1991 and 2025, the study analyzes the coverage of patriotism, national values, education, enlightenment, vocational guidance, physical education, and youth participation in public life. Furthermore, the article explores the role of regional print media in preserving historical memory, shaping public attitudes, and educating the younger generation in the spirit of spiritual and moral values.*

***Keywords:** Navoi region, print media, youth education, spiritual values, historical memory.*

KIRISH

Jamiyatning ma’naviy taraqqiyoti, avvalo, yosh avlodning intellektual darajasi, axloqiy fazilatlari, tarixiy xotirasi va milliy qadriyatlarga munosabati bilan uzviy bog‘liq. Har bir tarixiy davrda yoshlar tarbiyasi davlat va jamiyat oldida turgan dolzarb vazifalardan biri bo‘lib kelgan. O‘zbekiston mustaqillikka erishganidan keyin ushbu masala yangi ijtimoiy-siyosiy mazmun kasb eta boshladi. Yoshlarni milliy istiqlol g‘oyalari, vatanparvarlik, tarixiy merosga hurmat va fuqarolik mas’uliyati ruhida tarbiyalashga qaratilgan faoliyatda ommaviy axborot vositalarining o‘rni yanada ortdi. O‘zbekiston Respublikasi Prezidenti Shavkat Mirziyoyev 2020-yil 25-dekabrda O‘zbekiston yoshlari forumida so‘zlagan nutqida: “Yoshlar bilan ishlash Prezidentdan tortib vazirgacha, hokimdan tortib mahalla raisigacha – hammamizning eng asosiy ishimizga aylanishi zarur”, deb ta’kidlagan [1]. Ushbu fikr yoshlar tarbiyasi davlat boshqaruvi organlari bilangina cheklanmasdan, ta’lim muassasalari, mahalla, oila va keng jamoatchilikning hamkorligini talab etishini ko‘rsatadi.

ASOSIY QISM

Tarixiy jarayonlarni o‘rganishda bosma ommaviy axborot vositalari qimmatli ahamiyatga ega. Chunki davriy matbuot sahifalarida muayyan davrning ijtimoiy-siyosiy muhiti, madaniy hayoti, ma’naviy qadriyatlari hamda jamoatchilik e’tiborida bo‘lgan muammolar aks etadi. Ayniqsa, hududiy gazetalar mahalliy jamiyat hayotidagi voqealarni muntazam yoritib borishi bilan respublika miqyosidagi nashrlardan farqlanadi. Navoiy viloyatida chop etilgan “Do‘stlik bayrog‘i” va

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“Знамя дружбы” gazetalari hudud tarixini o‘rganishda muhim manbalar hisoblanadi. Mazkur nashrlarda yoshlarning ta’lim olishi, kasb-hunar egallashi, sport va madaniyatdagi yutuqlari, milliy qadriyatlarga munosabati hamda ijtimoiy hayotdagi ishtiroki bilan bog‘liq materiallar e’lon qilingan.

Navoiy viloyati bosma matbuotining yoshlar tarbiyasidagi faoliyatini tarixiy jihatdan o‘rganishda mustaqillikning dastlabki yillari alohida ahamiyatga ega. Mazkur davrda jamiyatda milliy o‘zlikni anglash, tarixiy xotirani tiklash, davlat mustaqilligining mazmun-mohiyatini tushuntirish va yangi ijtimoiy qadriyatlarni shakllantirish jarayonlari kechdi. 1990-yillarda davriy matbuot sahifalarida mustaqillikning tarixiy ahamiyati, milliy davlatchilik, ona tiliga hurmat, ajdodlar merosi va vatanparvarlik masalalarining yoritilishi mazkur jarayonlarning muhim ko‘rinishlaridan biri bo‘ldi. Jumladan, “Знамя дружбы” gazetasining 1993-yil 31-avgust sonida “По пути независимости – к светлому будущему” nomli maqola e’lon qilingan [2]. Unda mustaqillik davrining dastlabki yillariga xos bo‘lgan kelajakka ishonch, taraqqiyotga intilish va milliy davlatchilikni mustahkamlash g‘oyalari mujassamlashgan.

Navoiy viloyati bosma matbuotida milliy qadriyatlar mavzusining yoritilishi yoshlar ma’naviy-axloqiy tarbiyasi bilan bevosita bog‘liq. Zero, yosh avlodning o‘z tarixini bilishi, ajdodlar merosini qadrlashi, milliy urf-odat va an’analarga hurmat bilan munosabatda bo‘lishi ma’naviy tarbiyaning muhim tarkibiy qismlaridan hisoblanadi. Hududning Alisher Navoiy nomi bilan atalishi ham ma’naviy-ma’rifiy mavzularni tarixiy meros bilan bog‘lab yoritish uchun muhim madaniy asos yaratadi. Yoshlar ma’naviy-axloqiy tarbiyasida ta’lim va ma’rifat alohida o‘rin tutadi. Bilimli, mustaqil fikrlaydigan va ijtimoiy mas’uliyatni his etadigan avlodni tarbiyalashda maktab, oila va jamoatchilikning o‘zaro hamkorligi muhim ahamiyat kasb etadi. Ushbu jarayonda bosma matbuot ta’lim sohasidagi yangiliklarni keng jamoatchilikka etkazish, ilg‘or tajribalarni ommalashtirish va mavjud muammolarni muhokama qilish imkoniyatiga ega bo‘lgan.

Yoshlar tarbiyasi masalasi davlat siyosati, jamoatchilik faoliyati va ijtimoiy munosabatlar bilan uzviy bog‘liqdir. Mustaqillik yillarida O‘zbekistonda yoshlarga oid davlat siyosatining huquqiy va tashkiliy asoslari takomillashib bordi. Bu jarayon hududiy ommaviy axborot vositalari faoliyatida ham o‘z ifodasini topdi. Yoshlarga oid davlat siyosatining gazetalarda yoritilishi yosh avlodning huquqiy savodxonligini oshirish, jamiyatdagi o‘z o‘rnini anglash va ijtimoiy mas’uliyatini kuchaytirish bilan bog‘liq ma’rifiy vazifalarni bajarishi mumkin. Bunday materiallar orqali davlat va jamiyat tomonidan yoshlar oldiga qo‘yilgan vazifalar, ularga yaratilayotgan imkoniyatlar hamda yoshlarning ijtimoiy hayotdagi ishtiroki haqida tasavvur hosil qilish mumkin.

Yoshlarning ijtimoiy faolligini rivojlantirishda madaniy tadbirlar, sport musobaqalari, ijodiy uchrashuvlar va jamoatchilik tashabbuslari bilan bir qatorda, ularni turli salbiy illatlardan asrash, sog‘lom turmush tarziga yo‘naltirish ham muhim ahamiyat kasb etadi. Jumladan, “Знамя дружбы” gazetasida e’lon qilingan **“Профилактика наркомании”** nomli maqolada yoshlar o‘rtasida giyohvandlikning oldini olish, huquqni muhofaza qiluvchi organlarning ta’lim muassasalarida olib borayotgan tushuntirish ishlari hamda oilaviy tarbiyaning ahamiyati yoritilgan [3]. Bu esa hududiy bosma matbuotning yoshlar o‘rtasida huquqiy madaniyatni shakllantirish, zararli odatlarning oqibatlari haqida ogohlantirish va sog‘lom ijtimoiy muhitni targ‘ib qilishdagi o‘rnini ko‘rsatadi.

Mazkur material yoshlarning jamoaviy faoliyati va madaniy muloqotiga oid tarixiy ma’lumotlarni o‘rganishda ahamiyatlidir. Bunday tadbirlarning hududiy matbuotda aks ettirilishi yoshlarning ijtimoiy hayotdagi ishtirokini keng jamoatchilikka tanishtirish imkonini bergan. Shu jihatdan Navoiy viloyati bosma matbuoti faqat axborot etkazuvchi vosita emas, balki yoshlarning ijtimoiy faolligi va ma’naviy kamolotiga oid jarayonlarni hujjatlashtirib borgan tarixiy manba sifatida ham baholanishi mumkin.

XXI asrning uchinchi o‘n yilligida yoshlar tarbiyasi bilan bog‘liq masalalar yangi ijtimoiy-iqtisodiy sharoitda yanada keng mazmun kasb etdi. Xususan, yoshlarni kasb-hunarga yo‘naltirish, ularning tadbirkorlik ko‘nikmalarini rivojlantirish, milliy hunarmandchilik an’analarini davom ettirish va sog‘lom turmush tarzini targ‘ib qilish muhim yo‘nalishlarga aylandi. “Знамя дружбы” gazetasining 2024-yil 17-oktabr sonida “Названы лучшие авторы социальных инициатив” maqolasi e’lon qilingan [4]. Unda Navoiy shahridagi 6-umumta’lim maktabi o‘qituvchisi Baxriniso Berdiyevaning faoliyati yoritilib, o‘quvchilarni kasbga yo‘naltirish, ularga milliy hunarmandchilikni o‘rgatish muhim ahamiyat kasb etishi qayd etiladi. Qayd etish kerakki, yoshlarni milliy hunarmandchilikka o‘rgatish orqali ularda mehnatsevarlik, sabr-toqat, mas’uliyat va milliy qadriyatlarga hurmat kabi fazilatlarni shakllantirish imkoniyati yuzaga keladi. Shu sababli bunday tashabbuslarning mahalliy matbuotda yoritilishi tarixiy-madaniy meros va zamonaviy tarbiya jarayonlari o‘rtasidagi bog‘liqlikni o‘rganishda muhim ahamiyatga ega.

Hududiy bosma matbuotda yoshlarning jismoniy tarbiyasi va sportdagi muvaffaqiyatlari ham yoritib borilgan. Xususan, “Навоийские гимнасты покоряют помосты” sarlavhali materialda Navoiy shahridagi “Yoshlar” sport majmuasida o‘tkazilgan badiiy gimnastika musobaqasida 70 nafar qiz ishtirok etganligi aytilib, ushbu ma’lumot viloyatda yosh qizlarning sportga jalb etilishi va jismoniy tarbiya sohasidagi faoliyatini o‘rganishda aniq tarixiy dalil bo‘lib xizmat

qiladi [5]. Sportga oid materiallar yoshlarning yutuqlarini keng jamoatchilikka tanishtirish bilan birga, sog‘lom turmush tarzi, intizom, qat’iyat va maqsad sari intilish kabi fazilatlarni targ‘ib qilish imkoniyatiga ega.

Navoiy viloyati bosma ommaviy axborot vositalarining yoshlar tarbiyasidagi o‘rnini tadqiq etishda manbashunoslik yondashuvi muhim ahamiyatga ega. Chunki gazeta materiallari muayyan tarixiy davrning ijtimoiy muhitini, davlat siyosati va jamoatchilik qarashlarini aks ettiradi. “Do‘stlik bayrog‘i” va “Знамя дружбы” gazetalarining turli yillardagi sonlarini qiyoslash yoshlar tarbiyasiga oid mavzularning mazmunan o‘zgarib borganini kuzatish imkonini beradi. Xususan, tanlab o‘rganilgan materiallarda 1990-yillarda mustaqillik va vatanparvarlik, 2000-yillarda ta’lim va ma’rifat, 2010-yillarda yoshlar siyosati va ijodiy faollik, 2020-yillarda esa kasbiy tayyorgarlik, ijtimoiy tashabbuskorlik hamda sog‘lom turmush tarzi bilan bog‘liq mavzular ko‘zga tashlanadi.

XULOSA

Navoiy viloyati bosma ommaviy axborot vositalarining yoshlar ma’naviy-axloqiy tarbiyasidagi o‘rnini tarixiy jihatdan o‘rganish natijasida bir qator xulosalarga kelish mumkin. Birinchidan, “Do‘stlik bayrog‘i” va “Знамя дружбы” gazetalarida yoshlar tarbiyasi bilan bog‘liq masalalar turli tarixiy davrlarda yoritilgan. Xususan, mustaqillik, milliy qadriyatlar, ta’lim, ijodkorlik, kasbiy tayyorgarlik, sport va ijtimoiy faollikka oid materiallar mahalliy matbuotning muhim mavzularidan bo‘lgan. Ikkinchidan, gazetalarda yoshlarning ta’lim va madaniyat sohasidagi faoliyati, ijodiy yutuqlari hamda ijtimoiy tashabbuslari aks ettirilishi hududiy matbuotning ma’rifiy va axborot berish vazifalarini namoyon etadi. Uchinchidan, ikki tildagi nashrlarning faoliyati yoshlar tarbiyasiga oid axborotlarni turli til guruhlariga mansub o‘quvchilarga etkazish imkoniyatini yaratgan. To‘rtinchidan, bosma matbuot materiallari yoshlar tarbiyasi bilan bog‘liq tarixiy jarayonlarni o‘rganishda muhim birlamchi manba hisoblanadi. Ular orqali muayyan davrning ijtimoiy qarashlari, ma’naviy qadriyatlari va yoshlar siyosatiga oid tashabbuslarini tadqiq etish mumkin. Shunday qilib, Navoiy viloyati bosma ommaviy axborot vositalari tarixini yoshlar tarbiyasi bilan bog‘liq holda o‘rganish hududning ijtimoiy-madaniy taraqqiyotini yanada chuqurroq yoritishga xizmat qiladi.

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ЎЗБЕКИСТОНДА СУДЬЯЛАРНИНГ ИНТИЗОМИЙ ЖАВОБГАРЛИГИ ТЎҒРИСИДАГИ ҚОНУНЧИЛИКНИ ҚЎЛЛАШ АМАЛИЁТИНИ ТАКОМИЛЛАШТИРИШ

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Аннотация. *Тезисда судьяларнинг интизомий жавобгарлиги тўғрисидаги қонунчиликни қўллаш амалиёти 2025–2026 йиллардаги расмий маълумотлар асосида таҳлил қилинган. Қўллаш амалиётида тўрт босқичда муаммолар борлиги асосланган: айбни объектив шароитдан ажратиш мезонларининг йўқлиги, мурожаатчиларнинг шикоят қилиш тартиби ва муддатларини билмаслиги, хизмат текшируви тартибининг етарли тартибга солинмагани ва малака ҳайъатлари амалиётининг бир хил эмаслиги. Таклифлар судья мустақиллиги ва айбсизлик презумпцияси кафолатларини сақлаган ҳолда ишлаб чиқилган.*

Калит сўзлар: *судья мустақиллиги, интизомий жавобгарлик, қўллаш амалиёти, процессуал муддатлар, судьялар малака ҳайъати, Судьялар олий кенгаши, фуқаролар мурожаатлари, хизмат текшируви, Бангалор принциплари.*

Кириш

Сўнгги йилларда мамлакатимизда суд ҳокимиятининг чинакам мустақиллигини таъминлаш, судьяларнинг ҳуқуқий мақоми ва ижтимоий кафолатларини мустаҳкамлаш борасида кенг кўламли ислоҳотлар амалга оширилмоқда. 2023 йилда янги таҳрирда қабул қилинган Конституциямизнинг 136-моддасида судьяларнинг мустақиллиги қатъий белгилаб қўйилди; судьяни ишнинг муҳокамасидан четлаштириш, ваколатларини бекор қилиш ёки тўхтатиб туриш эса фақат қонунда белгиланган тартибда ва асосларга кўра амалга оширилади. Айни пайтда Конституциянинг 55-моддаси ҳар кимга иши қонунда белгиланган муддатларда мустақил ва холис суд томонидан кўриб чиқилиши ҳуқуқини кафолатлайди[1]. Судьяларнинг интизомий жавобгарлиги институти айнан шу икки конституциявий қадрият ўртасидаги кўприкдир: у

[1]Ўзбекистон Республикасининг Конституцияси (2023 йил 30 апрелдаги таҳрири). 55, 136-моддалар // https://lex.uz/docs/6445145

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судьяни асоссиз таъқибдан, фуқарони эса судьянинг бепарволигидан ҳимоя қилиши лозим.

Институтнинг қонунчилик асоси бугунги кунда асосан шаклланган. «Судлар тўғрисида»ги Қонуннинг 74–77-моддаларида жавобгарлик асослари, ишни хизмат текшируви натижасига кўра малака ҳайъати томонидан қўзғатиш тартиби, беш турдаги жазо чоралари ва уларни танлаш мезонлари, шикоят қилиш тартиби белгиланган; суд қарорининг бекор қилиниши эса, қонун қасддан бузилмаган бўлса, ўз-ўзидан жавобгарликка сабаб бўлмайди[2]. Ўзбекистон Республикаси Олий Мажлисининг 2001 йил 7 декабрдаги қарори билан тасдиқланган ва 2014 йилда янги таҳрирда қабул қилинган Судьялар малака ҳайъатлари тўғрисидаги низомда судьянинг ҳуқуқлари, қўшимча текширув ва жазо қўллаш муддатлари (қилмиш аниқланган кундан бир ой, содир этилган кундан олти ой) тартибга солинган[3]. Демак, бугун масала нормаларнинг борлигида эмас, балки уларнинг амалда қандай қўлланаётганида. Бу давлат сиёсати даражасида ҳам эътироф этилган. Президентимизнинг 2025 йил 24 ноябрдаги ПФ-227-сон Фармонининг 14-бандида интизомий жавобгарлик тизимини шаффоф ва адолатли қилиш, судьяга ҳимояланиш ҳуқуқини бериш ва жавобгарликнинг аниқ мезонларини белгилаш таклифлари маъқулланган[4], 2026 йил 8 июндаги ПФ-106-сон Фармон йўл харитасининг 11-бандида эса интизомий чораларни қўллаш механизмларини такомиллаштириш бўйича таклифларни 2026 йил ноябрь ойида киритиш Судьялар олий кенгашига (кейинги ўринларда — Кенгаш) топширилган[5]. Қонунчилик палатаси 2026 йил 8 сентябрда биринчи ўқишда қабул қилган «Судьяларнинг мақоми тўғрисида»ги қонун лойиҳаси[6] эса бу таклифларни қонунга киритиш имкониятидир. Шу боис тезиснинг мақсади қўллаш амалиётидаги муаммоларни босқичма-босқич аниқлаш ва уларни судья мустақиллиги кафолатларига зид келмайдиган тарзда бартараф этиш бўйича таклифлар беришдир.

Асосий қисм

[2]Ўзбекистон Республикасининг «Судлар тўғрисида»ги Қонуни. 2021 йил 28 июль, ЎРҚ-703-сон. 74–77-моддалар // https://lex.uz/docs/5534923

[3]Судьялар малака ҳайъатлари тўғрисидаги низом. Ўзбекистон Республикаси Олий Мажлисининг 2001 йил 7 декабрдаги 323-II-сон қарори билан тасдиқланган (2014 йил 22 апрелдаги ЎРҚ-368-сон Қонун таҳририда, амалдаги таҳрири). 49–55-моддалар // https://lex.uz/docs/300090

[4]Ўзбекистон Республикаси Президентининг «Судьялар ҳамжамияти органлари фаолиятининг самарадорлиги ва очиқлигини ошириш ҳамда суд мустақиллиги кафолатларини янада кучайтириш чора-тадбирлари тўғрисида»ги Фармони. 2025 йил 24 ноябрь, ПФ-227-сон. 7, 14-бандлар // https://lex.uz/docs/7852946

[5]Ўзбекистон Республикаси Президентининг «Судларда комплаенс назорат тизими самарадорлигини оширишнинг қўшимча чора-тадбирлари тўғрисида»ги Фармони. 2026 йил 8 июнь, ПФ-106-сон. Йўл харитаси, 11-банд // https://www.lex.uz/ru/docs/-8255886

[6]Судьяликка номзодлар учун ёш цензи 30 ёшга туширилиши мумкин // Gazeta.uz. 08.09.2026. https://www.gazeta.uz/uz/2026/09/08/sudyalar-maqomi/

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Амалиётни баҳолашни расмий рақамлардан бошлаш лозим. Судьялар олий кенгаши раисининг 2026 йил 12 февралда Президентга тақдим этган ахборотига кўра, 2025 йилда 266 нафар судья интизомий жавобгарликка тортилган, 59 нафар судьянинг ваколатлари муддатидан илгари тугатилган, шулардан 19 нафари қасамёд ва Судьялар одоби кодекси талабларини бузганлиги учун лавозимидан озод этилган, 58 нафарининг лавозими пасайтирилган, 3 нафар судья жиноий жавобгарликка тортилган[7]. Кўриниб турибдики, жиноий ишлар умумий рақамнинг жуда кичик қисми; интизомий амалиётнинг асосий қисми эса кундалик суд фаолиятидаги оддий қоидабузарликлардир: ишни процессуал қонунчиликда белгиланган муддатда кўрмаслик, суд мажлисини асоссиз қолдириш, тарафларни лозим даражада хабардор қилмаслик, қарорнинг тўлиқ матни ёки нусхасини ўз вақтида бермаслик, иш иштирокчиларига нисбатан қўпол муомала. Айнан шу ҳолатлар фуқаронинг Конституция 55-моддасидаги ҳуқуқига дахл қилади ва Қонуннинг 74-моддасидаги «ишни ташкил этишда бепарволик ва интизомсизлик» асосига тўғри келади.

Бироқ бу асосни қўллашда биринчи муаммо юзага чиқади: муддат бузилишининг қай бири судьянинг шахсий айби-ю, қай бири тизимнинг объектив юкламаси экани қонунда ажратилмаган. Олий суднинг 2026 йил 4 февралдаги матбуот анжуманида келтирилган маълумотларга кўра, 2025 йилда судлар 4 миллиондан ортиқ ишни кўриб чиққан, бу 2024 йилга нисбатан 37 фоизга кўп; тизимда 1700 дан ортиқ судья фаолият юритади ва бир судьянинг ойлик иш ҳажми ўртача 532 ишни ташкил этади, ҳолбуки халқаро амалиётда бу кўрсаткич ойига 16 та иш атрофида[8]. Бунинг устига, 2025 йилда вилоят судлари раисларининг 231 та буйруғи билан 314 нафар судьяга одил судлов билан боғлиқ бўлмаган вазифалар юклатилгани аниқланган. Т. Каримов ҳақли равишда таъкидлаганидек, «қонунийликни бузиш» ва «ишни ташкил этишдаги бепарволик» тушунчаларини баҳолаш мезонлари қонунда очиб берилмагани амалиётда турлича талқинга йўл очади[9]; OECD нинг 2024 йилги мониторинг ҳисоботида ҳам асослар ҳаддан ташқари кенг ифодалангани қайд этилган[10]. Натижада бир ҳолатда юкламадан эзилган судья жазоланади, бошқасида такрорий кечиктиришлар «объектив сабаб»

[7]Суд ҳокимияти мустақиллигини таъминлаш ва тизимда коррупцияга қарши курашишнинг ҳолати кўриб чиқилди // Ўзбекистон Республикаси Президентининг расмий веб-сайти. 12.02.2026. https://president.uz/uz/lists/view/8934

[8]«2025 йилда судлар 4 млн дан зиёд ишни кўриб чиқди». Олий суд вакилларининг матбуот анжумани // Gazeta.uz. 06.02.2026. https://www.gazeta.uz/uz/2026/02/06/courts/

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билан оқланади. Шуни алоҳида таъкидлаш лозимки, юклама муаммоси интизомий жавобгарликдан озод қилиш асоси эмас, балки суд тизимини ташкил этишга оид, давлат томонидан штатларни кенгайтириш ва рақамлаштириш орқали ҳал этилиши лозим бўлган масаладир; интизомий норма эса айнан судьянинг шахсий айбини аниқ ифодалаши керак.

Мезон масаласи ҳал этилганда ҳам механизм ўз-ўзидан ишга тушмайди. Қонуннинг 75-моддасига кўра интизомий иш ариза ёки хабар асосида ўтказилган хизмат текшируви натижасида қўзғатилади, яъни биринчи туртки кўп ҳолларда фуқаронинг мурожаатидир; «Жисмоний ва юридик шахсларнинг мурожаатлари тўғрисида»ги Қонун эса ҳар кимга бундай мурожаат қилиш ва асослантирилган жавоб олиш ҳуқуқини беради[11]. Бунда мурожаатчининг ҳуқуқий ҳолатини тўғри тушуниш муҳим: интизомий иш юритуви судьялар ҳамжамияти органи билан судья ўртасидаги ички хизмат муносабати бўлиб, фуқаро унда тараф эмас, балки қоидабузарлик ҳақида хабар берувчи шахс ҳисобланади. Шу ўринда иккинчи муаммо — мурожаатчиларнинг шикоят қилиш тартиби ва муддатларини билмаслиги — намоён бўлади. Аввало, фуқаролар судьянинг хатти-ҳаракати устидан шикоят билан суд қарорига нисбатан норозиликни фарқламайди: Кенгаш сайтида эълон қилинадиган мурожаатлар таҳлилига кўра, келиб тушадиган мурожаатларнинг асосий қисми суд қарорларидан норозилик билан боғлиқ бўлиб, судьянинг хатти-ҳаракати устидан шикоятлар уларнинг кичик бир қисмини ташкил этади[12]. Ҳолбуки Кенгаш ва малака ҳайъатлари суд қарорини қайта кўрадиган инстанция эмас; бундай мурожаатлар қайтарилади, муддатни бузиш каби ҳақиқатан жазоланиши лозим ҳолатлар эса шикоятда умуман тилга олинмайди. Қолаверса, фуқаролар жазо қўллашнинг олти ойлик муддатини билмайди: аввал апелляция ва кассация инстанцияларида ойлар давомида ўз ҳақлигини исботлашга уринади ва фақат шундан кейин судьянинг хатти-ҳаракати ҳақида шикоят қилишни ўйлайди. Шу вақтга келиб муддат тугаган бўлади ва судья қоидабузарлик бўлмагани учун эмас, хабар кеч келгани учун жавобгарликдан четда қолади. Бундан ташқари, Низомда мурожаатчини мурожаат қабул қилингани ва текширув якуни тўғрисида хабардор қилиш тартиби аниқ белгиланмаган, шу боис мурожаатлар тўғрисидаги қонунда кафолатланган асослантирилган жавоб олиш ҳуқуқининг интизомий иш юритувида амалга оширилиши ҳайъат ихтиёрига боғлиқ бўлиб қолмоқда.

[11]Ўзбекистон Республикасининг «Жисмоний ва юридик шахсларнинг мурожаатлари тўғрисида»ги Қонуни (2017 йил 11 сентябрдаги ЎРҚ-445-сон Қонун таҳририда) // https://lex.uz/docs/3336171

[12]Судьялар олий кенгаши. Мурожаатлар таҳлили (2021–2025 йиллар) // https://sudyalaroliykengashi.uz/uz/menu/850

Мурожаат келиб тушган тақдирда ҳам учинчи муаммо кутиб туради: хизмат текшируви тартиби қонунчиликда етарли даражада тартибга солинмаган. Қонун ва Низомда текширувни ким ўтказиши, муддати, судьянинг текширув давомидаги ҳуқуқлари ва натижани расмийлаштириш шакли белгиланмаган; қўшимча текширув эса ҳайъат аъзосига топширилади, яъни текширувчи билан қарор қабул қилувчи бир шахсда бирлашади, бу OECD ҳисоботида ҳам танқид қилинган. Халқаро стандартларга кўра интизомий иш юритувининг дастлабки босқичлари, судьянинг ўзи бошқача талаб қилмаса, махфий сақланиши, бироқ судьяга адолатли тингланиш ҳуқуқи кафолатланиши лозим[13]. Бизнинг амалиётимизда эса махфийлик мавжуд-у, унга мувозанат бўлувчи процессуал кафолатлар йўқ: натижада текширув босқичи судья учун ҳимояланиш кафолатларисиз, мурожаатчи учун эса натижаси номаълум ҳолда қолмоқда.

Ниҳоят, ҳайъат қарор қабул қилганда тўртинчи муаммо — амалиётнинг бир хил эмаслиги — кузатилади. Интизомий ишларни ҳудудий малака ҳайъатлари кўради, аммо қарорлари умумлаштирилмайди ва эълон қилинмайди; натижада бир хил қилмиш учун бир вилоятда огоҳлантириш, бошқасида жарима қўлланиши мумкин. ПФ-227-сон Фармоннинг 7-бандида Кенгаш раисига жазоси қилмишга номутаносиб ишлар бўйича ҳайъат қарорларини қайта кўриш масаласини қўйиш ваколати берилгани муаммо давлат даражасида эътироф этилганини кўрсатади. Юқори турувчи орган томонидан қуйи ҳайъатлар қарорларининг бекор қилиниши ёки ўзгартирилиши, кумулятив таъсир орқали, амалиётни бир хиллаштиришнинг асосий усули ҳисобланади; бироқ бу усул фақат қайта кўриш натижалари умумлаштирилиб, ҳудудий ҳайъатларга етказилса ва улар учун мўлжал бўлиб хизмат қилсагина тўлиқ самара беради. Ҳозирча бундай қарорлар тизимли равишда умумлаштирилмаётгани ва эълон қилинмаётгани боис ҳар бир ҳайъат ўз амалиётини давом эттирмоқда. Фармоннинг 14-бандида жазоси амал қилаётган судьяни юқори лавозимга тавсия этмаслик ҳам назарда тутилган, лекин жазолар ягона электрон реестрда юритилмас экан, бу қоида ҳам тўлиқ ишламайди.

Шундай қилиб, тўрт муаммо бир занжирни ташкил этади: ноаниқ мезон кеч ва нотўғри йўналтирилган мурожаатга, у эса кафолатларсиз текширувга ва бир хил бўлмаган қарорга олиб келади. Амалиётни такомиллаштириш шу занжирнинг ҳар бир ҳалқасига таъсир қилишни талаб қилади.

Таклиф ва хулосалар

[13]UNODC. Commentary on the Bangalore Principles of Judicial Conduct. Vienna: United Nations Office on Drugs and Crime, 2007 // https://www.unodc.org/documents/corruption/publications_unodc_commentary-e.pdf

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Биринчидан, Қонуннинг 74-моддасида процессуал муддатларни узрли сабабсиз ва такроран бузиш интизомий жавобгарликнинг аниқ асоси сифатида кўрсатилиши лозим. Бунда судьянинг иш юкламасини қонуний «узрли сабаб» сифатида белгилаш мақсадга мувофиқ эмас: бундай ёндашув ҳар қандай кечиктиришни юклама билан оқлаш имконини бериб, институтни амалда ишламайдиган ҳолга келтиради. Юклама муаммоси интизомий ҳуқуқ воситалари билан эмас, балки ташкилий чоралар — судьялар ва суд ходимлари штатини илмий асосланган меъёрлар бўйича кенгайтириш, суд иш юритувини рақамлаштириш ҳамда судьяларга одил судловга алоқасиз вазифалар юклатилишини қатъий тақиқлаш орқали ҳал этилиши керак. Шу билан бирга, қонунда назарда тутилган жазо чорасини танлаш мезонлари доирасида қилмишнинг содир этилиш шароити мутаносиблик талабига кўра ҳисобга олиниши мумкин.

Иккинчидан, Низомда мурожаатчининг мурожаат қабул қилингани ҳақида хабар олиш ва текширув якуни тўғрисида асослантирилган жавоб олиш ҳуқуқлари мустаҳкамланиши керак. Бунда интизомий иш юритувининг махфийлиги ва судья мустақиллиги кафолатлари сақланиши лозим: мурожаатчи ишда тараф бўлмагани учун унга ҳайъат мажлисида иштирок этиш ёки қарор нусхасини олиш ҳуқуқи берилмайди. Муддатларни ҳисоблаш қоидалари ҳам аниқлаштирилиши зарур: давомли қоидабузарлик учун олти ойлик муддат у тугаган кундан ҳисобланиши, қилмиш «аниқланган кун» деб эса мурожаат келиб тушган кун эмас, балки хизмат текшируви хулосаси тасдиқланган кун эътироф этилиши керак, чунки шикоят келиб тушган пайтда қоидабузарлик факти ҳали тасдиқланмаган бўлади ва уни аниқланган деб ҳисоблаш судьянинг айбсизлик презумпциясига зид келади. Судларда ва уларнинг сайтларида судьянинг хатти-ҳаракати устидан шикоят қилиш тартиби ва муддатлари ҳақида содда тилдаги ёднома ва электрон мурожаат шакли жойлаштирилиши лозим.

Учинчидан, хизмат текширувининг тартиби (ваколатли субъект, муддат, судьянинг ҳуқуқлари, натижани расмийлаштириш шакли) Низомда алоҳида боб сифатида белгиланиши, текширувда қатнашган ҳайъат аъзоси эса шу иш бўйича овоз беришдан четлаштирилиши зарур. ПФ-227-сон Фармонда назарда тутилган судьянинг ҳимояланиш ҳуқуқи ва Бангалор принципларида кафолатланган адолатли тингланиш ҳуқуқи айнан шу босқичдан бошлаб амал қилиши керак.

Тўртинчидан, Судьялар олий малака ҳайъати интизомий амалиётни ҳар йили умумлаштириб, шахсга доир маълумотларсиз қарорлар тўпламини эълон қилиши, Кенгаш раисининг ташаббуси билан қайта кўрилган ишларнинг

натижалари ҳудудий ҳайъатларга тавсиявий тушунтиришлар шаклида етказилиши, жазолар эса Кенгашнинг ягона электрон реестрида юритилиши мақсадга мувофиқ. Электрон суд тизимларида аллақачон мавжуд бўлган муддатлар мониторинги маълумотларидан эса суд раисининг судьяларга маъмурий таъсир воситаси сифатида эмас, балки хизмат текшируви давомида муддат бузилишининг тизимли ёки шахсий хусусиятга эга эканини аниқлашнинг объектив манбаи сифатида фойдаланиш лозим; бу суд тизими ичидаги мустақиллик (internal judicial independence) принципига мос келади.

Хулоса қилиб айтганда, судьяларнинг интизомий жавобгарлиги тўғрисидаги қонунчилик асосан шаклланган, такомиллаштиришнинг асосий резерви эса қўллаш амалиётида. Мезон, мурожаат, текширув ва қарор босқичларида юқоридаги чоралар судья мустақиллиги ва айбсизлик презумпцияси кафолатларига риоя этган ҳолда бир вақтда амалга оширилса, интизомий жавобгарлик институти жазо воситасидан кўра кўпроқ суд фаолияти сифатини ошириш ва одил судловга ишончни мустаҳкамлаш воситасига айланади. Ушбу таклифлар ПФ-106-сон Фармон йўл харитасидаги вазифани бажаришда инобатга олиниши мумкин.

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9. 🕮 LANGUAGE, LITERATURE AND GLOBAL COMMUNICATION: INTERCULTURAL DIALOGUE AND CONTEMPORARY RESEARCH APPROACHES.

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O‘ZBEK MILLIY REALIYALARINI INGLIZ TILIGA TARJIMA QILISH USULLARI

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Annotatsiya: *Milliy madaniyatni xalqaro auditoriyaga yetkazishda realiyalar tarjimasi asosiy qiyinchiliklardan biri hisoblanadi. Maqolada o‘zbek tilidagi 15 ta realiyaning ingliz tiliga berilish usullari qiyosiy, kontekstual va tasniflash usullari yordamida tahlil qilindi. Transkripsiya bilan qisqa izohni birlashtirgan kombinatsiyalangan usul eng samarali ekani, usul tanlash esa matn turi va o‘quvchiga bog‘liqligi asoslandi. Rus tili orqali o‘tgan shakllar o‘rniga o‘zbekcha asl shakllarni izchil qo‘llash taklif etildi.*

Kalit so‘zlar: *realiya, tarjima usuli, transkripsiya, kalka, tasviriy tarjima, ekvivalentlik, milliy kolorit.*

Abstract: *Translating realia is one of the main challenges in presenting national culture to an international audience. The article analyses how 15 Uzbek realia are rendered into English using comparative, contextual and classification methods. Combining transcription with a short explanation proves the most effective strategy, while the choice of method depends on text type and readership. Consistent use of original Uzbek-based forms instead of Russian-mediated ones is recommended.*

Keywords: *realia, translation strategy, transcription, calque, descriptive translation, equivalence, national colour.*

Kirish

O‘zbekistonning xalqaro turizm, madaniy va ilmiy hamkorlikdagi ishtiroki kengayib borar ekan, o‘zbek milliy madaniyatiga oid matnlarni ingliz tiliga tarjima qilishga bo‘lgan ehtiyoj ham ortmoqda. Bunday matnlarda tarjimon eng ko‘p qiyinchilikka uchraydigan birliklar realiyalardir. Realiyalar muayyan xalqning turmushi, urf-odatlari, tarixi va madaniyatiga xos bo‘lib, boshqa tillarda aniq muqobilga ega bo‘lmagan so‘zlardir. “Mahalla”, “hashar”, “sumalak”, “do‘ppi” kabi so‘zlar o‘zbek o‘quvchisi uchun tanish bo‘lsa-da, ingliz tilida so‘zlashuvchi o‘quvchi uchun izohsiz tushunarsiz qolishi mumkin. Ayniqsa, Samarqand, Buxoro, Xiva kabi tarixiy shaharlarga bag‘ishlangan turistik matnlar, milliy oshxona va

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hunarmandchilik haqidagi materiallar, shuningdek, o‘zbek badiiy adabiyotining ingliz tiliga tarjimalarida realiyalar ko‘p uchraydi.

Realiyalarni noto‘g‘ri yoki izchil bo‘lmagan tarzda tarjima qilish milliy koloritning yo‘qolishiga yoki, aksincha, matnning tushunarsiz bo‘lib qolishiga olib keladi. Shu bois tadqiqotning maqsadi o‘zbek milliy realiyalarini ingliz tiliga berish usullarini tasniflash, ularning afzallik va kamchiliklarini aniqlash hamda matn turiga qarab usul tanlash bo‘yicha tavsiyalar ishlab chiqishdan iborat.

Adabiyotlar tahlili va metodologiya

Realiyalar tarjimasi masalasi tarjimashunoslikda keng o‘rganilgan. S. Vlaxov va S. Florin realiyalarni predmet, mahalliy va vaqt belgilariga ko‘ra tasniflab, ularni tarjima qilishning asosiy yo‘llari sifatida transkripsiya, kalka, yangi so‘z yasash, taxminiy tarjima va tasviriy tarjimani ajratib ko‘rsatganlar (Влахов va Флорин, 1980). P. Nyumark esa madaniy so‘zlarni toifalarga ajratib, transferens, funksional ekvivalent, tavsifiy ekvivalent hamda bir necha usulni birlashtiruvchi kuplet va triplet usullarini taklif etgan (Newmark, 1988).

Tadqiqotchilar realiyaning o‘ziga xosligi uning faqat predmetni nomlashida emas, balki milliy va tarixiy kolorit tashishida ekanini ta’kidlaydilar (Влахов va Флорин, 1980). Boshqacha aytganda, realiya denotativ ma’no bilan birga muayyan madaniy assotsiatsiyalarni ham ifodalaydi. Masalan, “choyxona” so‘zi nafaqat choy ichiladigan joyni, balki erkaklarning suhbatlashadigan, mahalla hayoti muhokama qilinadigan an’anaviy maskanini ham anglatadi. Tarjimada aynan shu qo‘shimcha mazmunni saqlash asosiy qiyinchilik tug‘diradi.

M. Beyker so‘z darajasidagi ekvivalentsizlik holatlarini tahlil qilib, madaniyatga xos tushunchalarni berishda o‘zlashma so‘zni izoh bilan qo‘llash va tushuntirish orqali tarjima qilish strategiyalarini asoslagan (Baker, 2011). Y. Nayda formal va dinamik ekvivalentlikni farqlab, tarjima o‘quvchiga asl matn kabi ta’sir ko‘rsatishi lozimligini ilgari surgan (Nida, 1964). L. Venuti esa tarjimadagi xorijiylashtirish va mahalliylashtirish strategiyalarini bir-biriga qarama-qarshi qo‘yadi (Venuti, 1995). V.N. Komissarov tarjimaning lingvistik nazariyasida ekvivalentlik darajalarini ishlab chiqqan (Комиссаров, 1990). O‘zbek tarjimashunosligida G‘. Salomov va Q. Musayevning ishlarida milliy xususiyatlarni tarjimada saqlash masalasiga alohida e’tibor qaratilgan (Salomov, 1983; Musayev, 2005).

Tadqiqot materiali sifatida o‘zbek madaniyatining turli sohalariga, ya’ni taom, kiyim, maishiy turmush, ijtimoiy hayot, marosim va san’atga oid 15 ta realiya tanlab olindi. Har bir realiyaning ingliz tilidagi mumkin bo‘lgan berilish variantlari qiyosiy, kontekstual va tasniflash usullari asosida tahlil qilindi. Baholashda ikki mezon qo‘llandi: milliy koloritning saqlanishi va xorijiy o‘quvchi uchun tushunarlilik.

Natijalar va muhokama

Tahlil natijalari jadvalda umumlashtirilgan (1-jadvalga qarang).

1-jadval: O‘zbek realiyalarining ingliz tiliga berilish usullari

№	Realiya	Inglizcha berilishi	Tavsiya etilgan usul
1.	palov	plov	transkripsiya
2.	somsa	somsa (baked pastry with meat filling)	kombinatsiyalangan
3.	non	non (Uzbek round flatbread)	kombinatsiyalangan
4.	sumalak	sumalak (sweet wheat-sprout paste cooked for Navruz)	kombinatsiyalangan
5.	tandir	tandir (clay oven)	kombinatsiyalangan
6.	choyxona	choyxona (teahouse)	kombinatsiyalangan
7.	do‘ppi	doppi (embroidered skullcap)	kombinatsiyalangan
8.	chopon	chopon (quilted robe)	kombinatsiyalangan
9.	ko‘rpacha	korpacha (thin quilted floor mattress)	kombinatsiyalangan
10.	beshik	cradle	taxminiy tarjima
11.	mahalla	mahalla (self-governing neighbourhood community)	kombinatsiyalangan
12.	hashar	hashar (voluntary community work)	kombinatsiyalangan
13.	kelin salom	the bride’s greeting ceremony	tasviriy tarjima
14.	Navro‘z	Navruz (spring New Year festival)	kombinatsiyalangan
15.	dutor	dutor (two-stringed lute)	kombinatsiyalangan

Jadvaldan ko‘rinadiki, 15 ta realiyadan 12 tasida (80%) kombinatsiyalangan usul, ya’ni transkripsiya bilan qisqa izohni birga berish eng maqbul yo‘l sifatida baholandi. Bu usul P. Nyumark taklif etgan kuplet strategiyasiga mos keladi (Newmark, 1988). Masalan, “mahalla” so‘zini “neighbourhood” deb tarjima qilish uning o‘zini o‘zi boshqarish organi sifatidagi ijtimoiy-huquqiy mazmunini yo‘qotadi. “Mahalla (a self-governing neighbourhood community)” shakli esa ham

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milliy koloritni, ham tushunarlilikni ta’minlaydi. Matnda realiya ikkinchi marta uchraganda izohsiz qo‘llanishi mumkin.

Sof transkripsiya faqat ingliz tilida allaqachon o‘rnashgan realiyalar uchun maqbul. “Plov” va “pilaf” so‘zlari ingliz tili lug‘atlarida qayd etilgani sababli ularni izohsiz qoldirish mumkin. “Tandir” so‘zi bilan bog‘liq holat esa murakkabroq: ingliz tilida hind oshxonasi orqali kirgan “tandoor” shakli mavjud, biroq u o‘quvchida boshqa madaniyat bilan bog‘liq tasavvur uyg‘otishi mumkin. Shu sababli o‘zbekcha shaklni qisqa izoh bilan berish tavsiya etiladi.

Kalka usuli tahlil qilingan materialda kam uchraydi, biroq u ayrim hollarda samarali bo‘lishi mumkin. Masalan, “choyxona” so‘zining “teahouse” deb berilishi kalka hisoblanadi, chunki o‘zbekcha so‘zning ikki komponenti (choy + xona) inglizcha “tea” va “house” so‘zlari bilan aynan beriladi. Bunday kalka o‘quvchiga tushunarli, ammo yuqorida qayd etilgan madaniy mazmunni to‘liq ochib bermaydi. Shu sababli jadvalda “choyxona (teahouse)” shaklidagi kombinatsiyalangan variant tavsiya etildi: bunda kalka izoh vazifasini bajaradi.

Taxminiy tarjima realiyani unga yaqin vazifani bajaruvchi tushuncha bilan almashtirishni nazarda tutadi. “Beshik” so‘zining “cradle” deb berilishi axborot beruvchi matnlar uchun yetarli, ammo badiiy matnda o‘zbek beshigining o‘ziga xos tuzilishi va u bilan bog‘liq “beshik to‘yi” marosimi kabi madaniy mazmun yo‘qoladi. “Kelin salom” kabi marosim nomlarini transkripsiya qilish esa o‘quvchiga hech qanday ma’lumot bermaydi, shu bois bunday hollarda tasviriy tarjima maqsadga muvofiq.

Tahlil yana bir muhim jihatni ko‘rsatdi. Ingliz tilidagi manbalarda bir qator o‘zbek realiyalari rus tili orqali o‘tgan shaklda uchraydi: “chapan” (o‘zb. chopon), “chaikhana” (o‘zb. choyxona), “plov” (o‘zb. palov). Bu shakllar o‘zbek tilining fonetik qiyofasini emas, rus tilidagi talaffuzni aks ettiradi. L. Venuti ta’kidlaganidek, tarjimada tanlangan strategiya madaniyatning o‘quvchiga qanday ko‘rinishda taqdim etilishini belgilaydi (Venuti, 1995). Fikrimizcha, ingliz tilida mustahkam o‘rnashgan “plov” kabi shakllarni saqlab qolgan holda, yangi tarjimalarda o‘zbekcha asl shakllarga asoslangan transkripsiyani izchil qo‘llash lozim.

Transkripsiya bilan bog‘liq yana bir masala imlo me’yoriga taalluqli. O‘zbek lotin yozuvidagi “o‘” va “g‘” harflari ingliz tilida mavjud emasligi sababli “ko‘rpacha”, “do‘ppi”, “Navro‘z” kabi so‘zlar “korpacha”, “doppi”, “Navruz” shaklida beriladi. Bundan tashqari, transkripsiya qilingan realiyalar ingliz tilining grammatik qoidalariga bo‘ysunib, ko‘plik qo‘shimchasini qabul qiladi: “mahallas”, “doppis”. Bu holat realiyaning tarjima tiliga moslashib borayotganini ko‘rsatadi. Fikrimizcha, bitta matn yoki nashr doirasida yagona transliteratsiya tizimiga amal qilish va realiyani birinchi marta qo‘llashda izoh berish zarur.

Usul tanlashda matn turi hal qiluvchi ahamiyatga ega. Turizmga oid matnlarda kombinatsiyalangan usul o‘quvchini madaniyat bilan tanishtirish vazifasiga eng mos keladi. Rasmiy-huquqiy matnlarda, masalan, “mahalla” institutini tavsiflashda izohning aniqligi birinchi o‘ringa chiqadi. Badiiy tarjimada esa matnni izohlar bilan ortiqcha yuklamaslik uchun realiyaning ma’nosi kontekst orqali ochilishi yoki sahifa ostidagi izohdan foydalanilishi mumkin. Realiyalar ko‘p bo‘lgan yirik asarlarda kitob oxirida qisqa lug‘at berish ham o‘quvchi uchun qulay hisoblanadi. Bu yondashuv Y. Nayda ilgari surgan dinamik ekvivalentlik tamoyiliga mos keladi (Nida, 1964).

Olingan natijalar tarjimon kompetensiyasi uchun ham muhim xulosalar beradi. Realiyalarni to‘g‘ri tarjima qilish uchun tarjimon ikki tilni bilishi bilan cheklanmasdan, har ikki madaniyatni ham chuqur tushunishi lozim. U realiyaning madaniy mazmunini aniqlay olishi, o‘quvchining bilim darajasini oldindan baholay olishi va matn turiga mos usulni tanlay olishi kerak. Shu bois tarjimonlarni tayyorlashda lingvokulturologik bilimlarni rivojlantirish, realiyalar bilan ishlash bo‘yicha amaliy mashg‘ulotlarni ko‘paytirish maqsadga muvofiq.

Xulosa

O‘tkazilgan tahlil o‘zbek milliy realiyalarini ingliz tiliga berishning yagona universal usuli mavjud emasligini ko‘rsatdi. Tahlil qilingan realiyalarning aksariyatida transkripsiya bilan qisqa izohni birlashtirgan kombinatsiyalangan usul milliy kolorit va tushunarlilik o‘rtasidagi muvozanatni eng yaxshi ta’minlaydi. Sof transkripsiya faqat ingliz tilida o‘rnashgan so‘zlar uchun, taxminiy va tasviriy tarjima esa ayrim maishiy va marosim tushunchalari uchun o‘rinli. Rus tili orqali o‘tgan shakllar o‘rniga o‘zbekcha asl shakllarga asoslangan transkripsiyani izchil qo‘llash, shuningdek, o‘zbek realiyalarining ingliz tilidagi me’yoriy lug‘atini yaratish dolzarb vazifa hisoblanadi.

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CULTURAL VALUES IN ENGLISH IDIOMS: A COGNITIVE-LINGUISTIC PERSPECTIVE

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Annotatsiya. *Uşbu tezisda ingliz tilidagi idiomatik birliklarda mujassamlangan madaniy qadriyatlar kognitiv-lingvistik va pragmalingvistik nuqtayi nazardan tahlil qilinadi. Tadqiqot idiomalarning ma'nosi faqat sözlarning luğaviy yiğindisidan iborat emasligini, balki ular muayyan jamiyatning kognitiv bazasi, dunyoqaraşi va madaniy tasavvurlarini aks ettiruvçi lisoniy-mental hodisalar ekanligini asoslaydi. Özbekistonlik olim Ş. Safarovning ilmiy ğoyalariga tayanib, konseptual metafora, obrazli tafakkur, lisoniy şaxs va madaniy konnotatsiya tuşunçalari asosida "time", "work", "success" va "money" konseptlari bilan boğliq ingliz idiomalari körib çiqiladi. Tahlil şuni körsatadiki, idiomalar til va madaniyat örtasidagi uzviy aloqani namoyon etuvçi ziç madaniy modellar bölib, ularni örganiş ingliz tilidagi lisoniy ong tuzilişini çuqurroq anglaşga yordam beradi.*

Kalit sözlar: *ingliz idiomalari, madaniy qadriyatlar, kognitiv lingvistika, pragmalingvistika, konseptual metafora, lisoniy şaxs, lingvokulturologiya.*

Аннотация. *В тезисе рассматриваются культурные ценности, отражённые в английских идиомах, с позиции когнитивной лингвистики и прагмалингвистики. Подчёркивается, что значение идиоматических выражений не ограничивается суммой значений отдельных слов: оно формируется на основе ментального опыта, языкового сознания и культурно-когнитивных моделей сообщества. Опираясь на теоретические подходы отечественной школы (в частности, труды Ш. Сафарова), анализируются английские идиомы, связанные с концептами времени, труда, успеха и денег, через призму концептуальной метафоры и прагматической адаптации. Делается вывод о том, что идиомы служат важным инструментом трансляции культурных смыслов и организации языкового опыта.*

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Ключевые слова: *английские идиомы, культурные ценности, когнитивная лингвистика, прагмалингвистика, концептуальная метафора, языковая личность.*

Abstract. *This paper examines cultural values embedded in English idioms from a cognitive-linguistic and pragmalinguistic perspective. Building upon the theoretical frameworks of cognitive science and modern linguistic paradigms (such as those articulated by Sh. Safarov regarding linguistic categorization and mental representation), it argues that idiomatic meaning cannot be reduced to the literal composition of words. Instead, idioms function as compressed cultural models shaped by shared cognitive experiences and conceptual systems. Drawing on conceptual metaphor theory and pragmalinguistic interpretation, the paper discusses idioms associated with concepts of time, work, success, and money. The analysis demonstrates how these expressions encode societal values and reflect the interactive dynamics between language, thought, and culture.*

Keywords: *English idioms, cultural values, cognitive linguistics, pragmalinguistics, conceptual metaphor, linguistic personality, cultural conceptualisation.*

INTRODUCTION

Language is not merely a system for exchanging information; as noted in modern cognitive and pragmalinguistic paradigms, it is an active mental mechanism through which speakers organise experience, structure reality, and communicate culturally shared knowledge (Safarov, 2006). Idioms are particularly revealing in this respect because their conventional meanings are grounded in images, social practices, and cognitive models. Expressions such as “time is money” and “make ends meet” illustrate how abstract experiences are mapped onto concrete domains through conceptual projection.

A cognitive-linguistic and pragmalinguistic approach makes it possible to investigate not only the semantic structure of idioms, but also the mental operations, interpretive frameworks, and communicative intentions of the linguistic personality. The aim of this paper is to identify how selected English idioms encode cultural values and to explain the cognitive mechanisms underpinning their generation and usage across contexts.

THEORETICAL FRAMEWORK

Cognitive linguistics views language as inextricably connected with general human cognition, embodied experience, and categorization processes (Lakoff & Johnson, 1980; Safarov, 2006). Conceptual metaphors do not merely serve as stylistic devices; they fundamentally structure ordinary thought by allowing abstract

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domains to be comprehended through concrete source domains. Furthermore, Gibbs (1994) argues that idiomaticity is deeply rooted in human figurative thought, demonstrating that speakers comprehend idioms through underlying conceptual motivations rather than treating them as arbitrary dead metaphors.

From a linguocultural perspective, Wierzbicka (1992) highlights that language units encode culture-specific configurations and core societal values, serving as windows into a community's worldview. Similarly, Kövecses (2005, 2010) emphasizes that metaphorical conceptualisation is shaped by both universal bodily experiences and cultural variation across speech communities. Idioms act as conventionalised mental structures that reflect how a community categorises the world, functioning as fixed or semi-fixed units whose non-compositional meanings are motivated by metaphor, metonymy, and shared cultural scenarios (Fernando, 1996; Moon, 1998).

From a pragmalinguistic viewpoint, as emphasized by Uzbek scholar Sh. Safarov (2008), linguistic units acquire their true value within actual communicative activity, where the speaker's mental space, pragmatic intent, and cultural background converge.

ANALYSIS AND DISCUSSION

The analysis focuses on four core conceptual domains—time, work, success, and money—which are heavily conventionalised in English phraseology:

1. Time: Expressions such as “save time”, “waste time”, and “spend time” are driven by the conceptual metaphor TIME IS A RESOURCE. Borrowing financial verbs for temporal concepts reveals a cognitive model where time is finite, quantifiable, and subject to economic evaluation.

2. Work: Idioms like “keep your nose to the grindstone” and “work your fingers to the bone” materialize abstract diligence into intense physical exertion. These expressions invoke image schemas of repetitive bodily labour to highlight societal expectations of perseverance.

3. Success: Expressions such as “get ahead” (forward motion) and “climb the ladder” (upward movement) rely on foundational spatial schemas where vertical and horizontal axes symbolize achievement and ambition.

4. Money: The idiom “make ends meet” and the proverb “a penny saved is a penny earned” serve as compact pragmatic formulas for financial prudence, encoding practical socioeconomic wisdom.

As Charteris-Black (2004) notes within critical metaphor analysis, figurative expressions not only reflect conceptual mappings but also carry evaluative and persuasive functions in discourse. From a pragmalinguistic perspective, these idioms remain flexible: speakers can manipulate, ironize, or adapt them based on context,

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highlighting the dynamic interaction between fixed cognitive models and live communication (Safarov, 2008).

CONCLUSION

The study concludes that English idioms provide critical empirical evidence for the interplay between language, cognition, and culture. The conceptual patterns identified—treating time as a resource, effort as physical labour, achievement as movement, and financial stability as balance—demonstrate how embodied experience and cultural mentalities merge in phraseology. Integrating cognitive-linguistic mechanisms with pragmalinguistic principles ensures a comprehensive understanding of how idioms operate within human consciousness. Future research will focus on comparative cross-linguistic analyses between English and Uzbek idioms to map universal cognitive traits alongside culture-specific conceptualisations.

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CONCEPTUALIZING SPEAKING PROFICIENCY AT CEFR LEVEL B1: A DESCRIPTOR-BASED FRAMEWORK FOR MEDIA-ENHANCED ENGLISH LANGUAGE INSTRUCTION IN KARAKALPAK CLASSROOMS

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Abstract. *Speaking is widely regarded as the most demanding productive skill for intermediate learners, yet "B1 speaking" is often used in teaching and research without an explicit operational definition. This article presents a conceptual, document-based analysis of speaking proficiency at level B1 of the Common European Framework of Reference for Languages (CEFR), drawing principally on the illustrative descriptor scales of the Companion Volume (Council of Europe, 2020). Scales for spoken production, spoken interaction, communication strategies, and communicative language competences were coded and synthesised into a B1 speaking profile. The analysis shows that B1 speaking is characterised by reasonably fluent but visibly effortful production of linear discourse on familiar topics, interaction that depends partly on preparation and interlocutor support, and a noticeable influence of other languages on grammar and pronunciation. On this basis, the article proposes a descriptor-to-construct matrix linking CEFR scales to observable indicators of complexity, accuracy, fluency, and intelligibility, discusses the limits of the framework, and outlines implications for media-enhanced speaking instruction for Karakalpak-speaking learners of English.*

Keywords: *CEFR; B1; speaking proficiency; descriptor scales; media technologies; Karakalpak learners; English as a foreign language*

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Introduction

English language teaching in Uzbekistan has been reformed substantially over the past decade. National resolutions adopted in 2012 and 2021 oriented foreign language education towards outcomes referenced to the Common European Framework of Reference for Languages (CEFR) and called for more effective language learning (President of the Republic of Uzbekistan, 2012, 2021). In such a system, level B1 is of strategic importance: it marks the lower boundary of the

"independent user" and describes a learner who can deal with most situations likely to arise in everyday communication (Council of Europe, 2020).

Karakalpakstan presents a distinctive context for this reform. Learners typically grow up with Karakalpak as a home language and meet Uzbek and Russian in education and public life, so English is often a third or fourth language, and opportunities for authentic spoken English outside the classroom are limited. Under these conditions, media technologies such as video, podcasts, mobile applications, speech-recognition tools, and conversational agents may offer access to input, rehearsal, and interaction that the classroom alone cannot provide (Golonka et al., 2014).

The pedagogical value of any technology, however, depends on clarity about the learning target. The expression "B1 speaking" is frequently used as if its meaning were self-evident, although the CEFR describes speaking through many distinct scales rather than through a single construct (Council of Europe, 2020). Without an operational definition it is difficult to design tasks, select media tools, or measure progress transparently, and this gap is particularly consequential in experimental research, where the construct must be defined before it can be measured. This article therefore aims to conceptualise speaking proficiency at CEFR level B1 on the basis of the Companion Volume and to derive a framework that can guide the design and evaluation of media-enhanced instruction. Four research questions guide the analysis:

RQ1. What speaking profile does the CEFR Companion Volume describe at level B1?

RQ2. Which communicative language competences underlie B1 speaking performance?

RQ3. How can CEFR descriptors be operationalised as measurable constructs?

RQ4. What implications follow for media-enhanced instruction in Karakalpak classrooms?

The article proceeds as follows. Section 2 describes the method; Section 3 outlines the conceptual foundations of speaking in the CEFR; Sections 4 and 5 present the B1 profile and its underlying competences; Section 6 proposes the descriptor-to-construct matrix; Section 7 discusses limitations; and Sections 8 and 9 present implications and conclusions.

Method

2.1. Design and sources

The study employs qualitative document analysis, a systematic procedure for reviewing and interpreting documents in order to elicit meaning and develop

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empirical knowledge (Bowen, 2009). The primary document is the English edition of the CEFR Companion Volume (Council of Europe, 2020), which extends and updates the original framework (Council of Europe, 2001). Secondary sources comprise research on speaking pedagogy, second language performance, and technology-enhanced language learning.

2.2. Procedure and limitations

First, the parts of the Companion Volume containing speaking-related scales were identified: communicative language activities (spoken production and spoken interaction), communicative language strategies, and communicative language competences. Second, the B1 descriptors in these scales were extracted. Third, they were coded inductively according to (a) communicative function, (b) topic familiarity, (c) dependence on preparation or interlocutor support, (d) features of fluency and linguistic control, and (e) references to the influence of other languages. Fourth, the categories were compared with established models of speaking and second language performance to derive the matrix in Section 6. Descriptors are paraphrased throughout and accompanied by page references so that readers can verify the original wording. As a conceptual study, the article reports no learner data; the validity of the proposed matrix will be tested in later stages of the doctoral research.

Speaking in the CEFR: Conceptual Foundations

3.1. The action-oriented approach

The CEFR defines language use in terms of actions: learners are regarded as social agents who accomplish tasks in specific contexts, an orientation that Piccardo and North (2019) describe as the action-oriented approach. Outcomes are accordingly expressed as “can do” descriptors rather than as lists of structures (Little, 2006). The Companion Volume organises communication into reception, production, interaction, and mediation, and it extends the 2001 scales with online interaction scales, 19 scales for mediation, and descriptors for plurilingual and pluricultural competence. It also redeveloped the phonology scale around sound articulation and prosodic features and strengthened the description of plus levels such as B1+ (Council of Europe, 2020).

3.2. Production, interaction, and strategies

For speaking, the Companion Volume distinguishes spoken production, in which one speaker delivers an extended turn (pp. 61–65), from spoken interaction, in which speakers alternately produce and receive language and co-construct meaning (pp. 71–80). This distinction parallels Bygate’s (1987) separation of production and interaction skills and Goh and Burns’s (2012) holistic model, which combines language knowledge, core speaking skills, and communication strategies.

Strategy scales (planning, compensating, and monitoring and repair for production; turntaking, co-operating, and asking for clarification for interaction) show how learners manage limited resources in real time (pp. 68–70, 87–89). Levelt's (1989) model of speech production, with its stages of conceptualisation, formulation, and articulation, helps explain why B1 descriptors refer so often to planning, pausing, and repair: in a second language these stages compete for limited attention (Skehan, 1998). Notably, the Companion Volume places fluency within pragmatic competence and interprets it both narrowly, as access to one's repertoire, and broadly, as being an articulate speaker (p. 142).

3.3. Theoretical links

The emphasis on interaction is consistent with the interaction hypothesis, which assigns a central role to negotiation of meaning (Long, 1996), with the output hypothesis, which holds that producing language pushes learners to process it more deeply (Swain, 1985), and with sociocultural theory, in which learning is mediated by interaction and tools (Vygotsky, 1978). These perspectives justify the use of communicative tasks and, as argued in Section 8, of media that extend the opportunities for output and interaction.

The B1 Speaking Profile

4.1. Spoken production

At B1, the overall production descriptor portrays a learner who can reasonably fluently sustain a straightforward description of a familiar subject, presenting it as a linear sequence of points (p. 62). Scale-specific descriptors specify the functions involved: narrating stories, relating the plot of a book or film with personal reactions, and describing dreams, hopes, and unpredictable events (p. 62); reporting straightforward factual information and giving detailed directions, provided the learner can prepare beforehand (p. 63); and expressing opinions on everyday topics with brief reasons and explanations (p. 64). Two features deserve emphasis. First, the Companion Volume notes that its experience-describing scale offers little information about the quality of language, which must be sought in the competence scales (p. 62). Second, preparation is an explicit condition for information-giving, which implies that unprepared extended explanation is not yet expected at B1. For task design, rehearsal, planning time, and repeated performance are therefore legitimate features of B1 tasks rather than deviations from the level.

4.2. Spoken interaction

The overall interaction descriptor portrays a learner who can communicate with some confidence on familiar routine and non-routine matters: exchanging, checking, and confirming information, explaining why something is a problem, and expressing thoughts on cultural topics such as films or music (pp. 72–73). Conversation

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descriptors add that B1 learners can enter unprepared into conversations on familiar topics and sustain relatively long exchanges, but only provided the interlocutor makes an effort to support understanding, and that they may be hard to follow when trying to express exactly what they mean (p. 74). In informal discussion, learners can compare alternatives, comment briefly on others' views, and express agreement and disagreement politely (p. 75). Spontaneity at B1 is thus real but conditional on topic familiarity and interlocutor cooperation.

4.3. Strategies

Strategy descriptors show how B1 learners compensate for limited resources. In production, they can limit the message to what they can express, define the features of a concrete item when a word is missing, ask for confirmation that a form is correct, and start again with a different tactic when communication breaks down (pp. 69–70). In interaction, they can use stock phrases to gain time, intervene in a familiar discussion, summarise the point reached, repeat back part of what was said to confirm understanding, invite others in, and ask a speaker to clarify or elaborate (pp. 88–89). Table 1 summarises the profile, which answers RQ1: B1 speaking is linear discourse on familiar topics, conditional spontaneity, and strategic compensation.

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Table 1

Summary of the B1 Speaking Profile in the CEFR Companion Volume

Scale (page)	B1 profile (paraphrased)	Key feature
Overall oral production (p. 62)	Sustains a straightforward description of familiar subjects reasonably fluently as a linear sequence of points	Linear discourse
Describing experience (p. 62)	Narrates stories, relates plots, describes dreams, hopes, and unpredictable events, and reports reactions	Narration and description
Giving information (p. 63)	Reports straightforward facts and gives detailed directions, provided preparation is possible	Dependence on preparation
Putting a case (p. 64)	Expresses opinions on everyday topics and briefly gives reasons and explanations	Brief justification
Overall oral interaction (pp. 72–73)	Exchanges, checks, and confirms information; handles less routine situations; enters unprepared into talk on familiar topics	Partial spontaneity
Conversation (p. 74)	Sustains relatively long conversations on shared interests if the interlocutor supports understanding	Interlocutor support
Informal discussion (p. 75)	Compares alternatives, comments briefly on others' views, expresses (dis)agreement politely	Evaluative language
Production strategies (pp. 69–70)	Limits the message, defines concrete items, checks forms, restarts after breakdown	Compensation and repair
Interaction strategies (pp. 88–89)	Gains time with stock phrases, summarises, confirms, invites others, asks for clarification	Co-operation

Note. Page numbers refer to the Companion Volume (Council of Europe, 2020).

Competences Underlying B1 Speaking

Activity descriptors state what learners can do; competence scales state how well the language supports it. Vocabulary range at B1 is sufficient for familiar topics such as family, hobbies, work, travel, and current events, with some circumlocution (p. 131). Grammatical accuracy is characterised by reasonable accuracy in familiar contexts and good control of frequently used routines, but with noticeable mother-tongue influence; errors occur, yet the intended meaning remains clear (p. 132). The fluency descriptor indicates that learners can express themselves with relative ease and keep going without help, although problems of formulation produce pauses and dead ends, and planning and repair are very evident in longer stretches of free

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production (p. 142). The scale operationalises three ideas: constructing utterances despite hesitation, maintaining lengthy production, and ease and spontaneity of expression (p. 142). This is consistent with the distinction between speed, breakdown, and repair fluency in second language research (Skehan, 2009).

In the redeveloped phonology scale, B1 learners are generally intelligible despite regular mispronunciation of individual sounds and unfamiliar words, and they can convey their message intelligibly despite a strong influence of other languages on stress, intonation, and rhythm (pp. 133–135). The emphasis on intelligibility rather than accent agrees with research arguing that intelligibility and comprehensibility are the appropriate goals of pronunciation teaching (Derwing & Munro, 2015). Pragmatic competence adds flexibility, turntaking, thematic development, coherence and cohesion, and propositional precision (pp. 137–140), which matter for extended speech but are less developed at B1.

A distinctive feature of these scales is their explicit acceptance of other languages in the learner's repertoire: influence from them is treated as normal at B1 rather than as a deficit. This is relevant to Karakalpak learners. Karakalpak is an agglutinative Turkic language with subject–object–verb word order and no articles, and its sound system differs from that of English in several respects. These typological differences predict, but do not prove, areas of transfer in word order, article use, and prosody, which later empirical stages of this research will examine with learner data. The plurilingual descriptors (p. 123) further suggest treating Karakalpak, Uzbek, and Russian as resources for planning and compensating rather than as sources of interference. These findings answer RQ2.

From Descriptors to Measurable Constructs

Descriptors state what learners can do; they are not measurement instruments. To be used in instruction research they must be converted into constructs with observable indicators. The most widely used framework in second language performance research is the triad of complexity, accuracy, and fluency (CAF; Housen & Kuiken, 2009; Skehan, 2009), which aligns readily with CEFR scales: fluency with the fluency scale, accuracy with grammatical accuracy, and complexity with vocabulary range and discourse complexity. CAF alone, however, does not capture intelligibility, interaction, or strategy use, which are central to the CEFR conception of speaking. The matrix in Table 2 therefore extends CAF with intelligibility (Derwing & Munro, 2015) and with interactional and strategic indicators.

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Table 2

Descriptor-to-Construct Matrix for B1 Speaking

CEFR scale (page)	Construct	Example indicators	Media-based data
Fluency (p. 142)	Speed, breakdown, and repair fluency	Speech rate; mean length of run; frequency and length of silent pauses; self-repairs	Recorded video responses; podcast drafts
Vocabulary range (p. 131)	Lexical complexity and diversity	Length-corrected lexical diversity; use of circumlocution	Transcripts of recorded tasks
Grammatical accuracy (p. 132)	Accuracy	Proportion of error-free clauses; errors per 100 words; L1-related error types	Annotated transcripts
Phonological control (pp. 133–135)	Intelligibility and prosody	Listener-rated intelligibility and comprehensibility; word stress; rhythm	Rater judgments; speech-recognition scores
Interaction (pp. 72–76, 88–89)	Interactional competence	Turns per speaker; clarification requests; confirmation checks; inviting others in	Chatbot dialogues; paired tasks; online discussions
Strategies (pp. 69–70)	Compensation and repair	Circumlocution; reformulation; requests for confirmation	Learner diaries; stimulated recall

Note. Indicators are illustrative; thresholds for B1 are not provided by the CEFR and must be established empirically.

The matrix serves three purposes in the doctoral research. It defines the construct of B1 speaking; it provides the structure for a scoring rubric whose criteria can be traced to the CEFR; and it allows the same constructs to be tracked across media tasks, because recorded video, audio, and chat generate the transcripts and logs from which indicators can be computed. This answers RQ3.

Critical Perspectives and Limitations

The CEFR has been widely adopted but also criticised. Fulcher (2004) cautioned against its use as a tool of harmonisation and standardisation, Alderson (2007) called for more empirical research on the framework, and Hulstijn (2007) questioned whether the scales adequately reflect the quantitative and qualitative dimensions of proficiency. North (2000, 2014) showed that the descriptors were scaled empirically from teachers' judgments, which also means that they reflect perceptions of proficiency rather than performance data alone. Three limitations are relevant here. First, descriptors are illustrative and language-neutral: they do not

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specify the vocabulary, grammar, or sounds of English, so a B1 rubric needs supplementary criteria. Second, B1 covers a wide band, and learners at B1 and B1+ differ considerably. Third, apart from the online interaction scales, the framework says little about technology-mediated speaking and nothing about specific first-language backgrounds. These limitations do not undermine the CEFR as a reference point; they show the need to complement it with performance measures (Section 6) and diagnostic data on Karakalpak learners.

Implications for Media-Enhanced Instruction

The profile and the matrix have direct consequences for instructional design (RQ4). First, media tasks can be aligned with CEFR scales. Video-recorded monologues in which learners narrate an experience correspond to the describing-experience scale and permit planning and re-recording, which suits the role of preparation at B1. Podcasts and screencasts that explain a process or report facts correspond to the giving-information scale. Asynchronous voice or video discussions align with the online conversation and discussion scales (pp. 84–86), which describe group interaction from B1+ onwards. Role-play with conversational agents offers repeated practice of information exchange and clarification requests with a patient interlocutor, which is valuable because B1 interaction depends on interlocutor support. Speech-recognition applications can give immediate feedback on intelligibility, the CEFR criterion for B1 phonology, but their output should not be taken as proof of accuracy because systems vary in their tolerance of accented speech.

Second, design principles are needed to ensure that technology serves pedagogy: the multimedia learning principles (Mayer, 2009) and the TPACK framework (Mishra & Koehler, 2006) offer guidance on managing cognitive load and integrating technology, pedagogy, and content. Third, affective factors matter. Recording and rehearsal allow learners to prepare before performing publicly, which may reduce speaking anxiety (Horwitz et al., 1986) and support willingness to communicate (MacIntyre et al., 1998); this remains a hypothesis to be tested. Finally, the evidence base requires caution. Golonka et al. (2014) found support for several technologies but noted that the strength of evidence varies, and Plonsky and Ziegler (2016) reported generally positive effects of computer-assisted learning in a second-order synthesis while stressing variation in study quality. Rigorous quasi-experimental designs with constructs defined as in Table 2 are therefore needed.

Conclusion

This article conceptualised speaking proficiency at CEFR level B1 through a document analysis of the Companion Volume. The analysis showed that B1 speaking combines reasonably fluent, linear discourse on familiar topics with

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conditional spontaneity and strategic compensation (RQ1); that its quality is defined by range, accuracy, fluency, phonological control, and pragmatic competence, with other-language influence accepted as normal (RQ2); and that these descriptors can be translated into measurable constructs through a descriptor-to-construct matrix that extends the CAF triad with intelligibility, interaction, and strategies (RQ3). Implications for media-enhanced instruction concern task–scale alignment, principled design, affective support, and cautious interpretation of the evidence (RQ4). The principal limitation is that the framework is theoretical and requires empirical validation. In the subsequent stages of the doctoral research, it will inform the needs analysis of Karakalpak teachers and learners, the construction of assessment rubrics, and the design and evaluation of media-based speaking sequences.

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INGLIZ TILINI O‘QITISHDA KELISHMOVCHILIKNI YUMSHATISH KO‘NIKMALARINI SHAKLLANTIRISH: PRAGMATIK KOMPETENSIYA NUQTAYI NAZARIDAN

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Annotatsiya. *Maqolada o‘zbek tilida so‘zlashuvchi ingliz tili o‘rganuvchilarida kelishmovchilikni yumshatish ko‘nikmalarini shakllantirishning pragmatik asoslari va metodik yo‘nalishlari ko‘rib chiqildi. Maqsad pragmatik kompetensiya doirasida kelishmovchilikni bildirishdagi ehtimoliy qiyinchiliklarni aniqlash va ularni bartaraf etishga qaratilgan o‘qitish usullarini taklif etishdan iborat. Nazariy-tahliliy va chog‘ishtirma metodlardan, material sifatida tahlil maqsadida tuzilgan misollardan foydalanildi. Natijada beshta ehtimoliy pragmatik qiyinchilik va beshta o‘qitish yo‘nalishi ajratildi. Taklif etilgan yondashuvlar amaliyotda sinab ko‘rilmagan va keyingi tajribada tekshirilishi lozim.*

Kalit so‘zlar: *pragmatik kompetensiya, ingliz tilini o‘qitish, kelishmovchilik, yumshatish, xushmuomalalik, madaniyatlararo muloqot.*

Аннотация. *В статье рассматриваются прагматические основы и методические направления формирования умения смягчать несогласие у изучающих английский язык носителей узбекского языка. Цель – выявить вероятные прагматические трудности при выражении несогласия и предложить приёмы обучения для их преодоления. Использованы теоретико-аналитический и сопоставительный методы, материалом служили примеры, составленные для аналитических целей. Выделены пять вероятных прагматических трудностей и пять направлений обучения. Предлагаемые подходы не апробированы на практике и требуют проверки в дальнейшем опыте.*

Ключевые слова: *прагматическая компетенция, обучение английскому языку, несогласие, смягчение, вежливость, межкультурная коммуникация.*

Abstract. *The article examines the pragmatic foundations and methodological directions for developing the ability to mitigate disagreement among Uzbek-speaking learners of English. Its aim is to identify likely pragmatic difficulties in expressing disagreement and to propose teaching techniques that address them. Theoretical-analytical and contrastive methods were used, with illustrative*

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examples constructed for analytical purposes. Five likely pragmatic difficulties and five teaching directions are identified. The proposed approaches have not been tested in practice and require validation in further classroom research.

Keywords: *pragmatic competence, English language teaching, disagreement, mitigation, politeness, intercultural communication.*

KIRISH

Chet tilini o‘rganishda grammatika va lug‘at bilimi muloqotda muvaffaqiyatga erishish uchun yetarli emas: o‘rganuvchi muayyan vaziyatda qaysi ifoda o‘rinli ekanini ham bilishi kerak. Bunday bilim pragmatik kompetensiya deb ataladi, uning yetishmasligi esa grammatik jihatdan to‘g‘ri gapning ham noo‘rin yoki qo‘pol eshitilishiga olib kelishi mumkin [1]. Bu muammo ayniqsa kelishmovchilikni bildirishda seziladi, chunki bunday nutq aktida so‘zlovchi suhbatdosh fikriga qarshi chiqadi va uning yuzini saqlash zaruriyati yuzaga keladi.

Maqolaning maqsadi o‘zbek tilida so‘zlashuvchi ingliz tili o‘rganuvchilarida kelishmovchilikni yumshatish ko‘nikmalarini shakllantirishning pragmatik asoslarini ko‘rib chiqish, ehtimoliy qiyinchiliklarni aniqlash va o‘qitish yo‘nalishlarini taklif etishdan iborat. Tadqiqot nazariy-tahliliy va chog‘ishtirma metodlarga tayanadi. Material sifatida tahlil maqsadida tuzilgan misollar tanlandi; ular o‘quvchilar javoblari yoki sinf kuzatuvlari natijasi emas, shu sababli maqolada keltirilgan qiyinchiliklar farazli xarakterga ega.

ASOSIY QISM

1. Pragmatik kompetensiya va xushmuomalalik

Pragmalingvistika til resurslarining muayyan kommunikativ niyatni ifodalashdagi vazifasini, sotsiopragmatika esa ularning ijtimoiy kontekstga mosligini o‘rganadi [2]. Brown va Levinson nazariyasiga ko‘ra, kelishmovchilik suhbatdoshning ijobiy yuziga tahdid soladi va so‘zlovchilar uning ta’sirini kamaytiruvchi strategiyalardan foydalanadi [3]. Pomerantz tavsifiga ko‘ra, kelishmovchilik odatda kechiktirilgan, qisman rozilik yoki kirish so‘zlari bilan boshlangan shaklda beriladi [4]. Demak, ingliz tilida kelishmovchilikni o‘rinli bildirish uchun o‘rganuvchi nafaqat «yo‘q» deyishni, balki norozilikni e’tirof, xejlash va muqobil taklif bilan o‘rashni ham bilishi kerak.

2. Ehtimoliy pragmatik qiyinchiliklar

O‘zbek tilida so‘zlashuvchi o‘rganuvchilar ona tilidagi odatlarni ingliz tiliga ko‘chirishi mumkin. Nazariy tahlil va misollar asosida beshta ehtimoliy qiyinchilik ajratildi (1-jadval). Birinchisi yumshatuvchisiz to‘g‘ridan-to‘g‘ri e’tirozdir. Ikkinchisi qarama-qarshilik bildiruvchi *but* bog‘lovchisini e’tirofsiz qo‘llash. Uchinchisi ona tilidagi ifodani so‘zma-so‘z ko‘chirish: masalan, bilvosita

kelishmovchilikni bildirishi mumkin bo‘lgan *Bilmadim...* ifodasining *I don’t know* deb berilishi noaniqlik yoki bilimsizlik sifatida tushunilishi mumkin. To‘rtinchisi qisman rozilik vositalarining (*partly, up to a point*) bilinmasligi, beshinchisi esa suhbatdosh maqomiga mos shaklni tanlay olmaslikdir.

1-jadval. Ehtimoliy pragmatik qiyinchiliklar va tavsiya etiladigan variantlar

Ehtimoliy qiyinchilik	**Noo‘rin variant**	**Tavsiya etilgan variant**
Yumshatuvchisiz e’tiroz	*No, you are wrong.*	*I see your point, but I’m not sure that’s entirely correct.*
But e’tirofsiz	*But it is not true.*	*That’s a fair point, but I see it differently.*
So‘zma-so‘z ko‘chirish	*I don’t know...*	*I’m not sure about that.*
Qisman rozilik vositalarini bilmaslik	*Yes. / No.*	*That’s partly true. / I agree up to a point.*
Maqomga moslamaslik	*You are wrong, teacher.*	*Professor, if I may, I’d like to raise one point...*

Izoh. Misollar tahlil maqsadida tuzilgan, o‘quvchi javoblaridan olinmagan.

3. O‘qitish yo‘nalishlari

Ingliz tilida kelishmovchilikni yumshatishni o‘rgatishda pragmatik xususiyatlarni o‘quvchilar e’tiboriga havola qilish, tushuntirish va amaliy mashq qilishni birlashtirish tavsiya etiladi [6]. Quyidagi besh yo‘nalish taklif etiladi. Birinchisi chog‘ishtirma tahlil: o‘quvchilarga o‘zbek va ingliz tillaridagi parallel misollar (*Fikringizni tushunaman, lekin... – I see your point, but...*) taqdim etiladi va ularning vazifasi muhokama qilinadi. Ikkinchisi kelishmovchilik gradatsiyasi bilan ishlash: to‘liq rozilikdan ochiq norozilikkacha bo‘lgan bosqichlar (to‘liq rozilik, qisman rozilik, murosali norozilik, ochiq norozilik) bo‘yicha ifodalar tartiblanadi va vaziyatga qarab tanlanadi.

Uchinchisi maqom va vaziyat o‘zgaruvchisini o‘z ichiga olgan rol o‘yinlari: bir xil e’tiroz tengdosh, domla yoki notanish kishiga qaratilib, shakl farqi muhokama qilinadi. Maqom, kelishmovchilikning jiddiyligi va kontekst strategiya tanloviga ta’sir qilishi ko‘rsatilgan [7]. To‘rtinchisi yumshatish vositalarini aniqlash va almashtirish vazifalari: o‘quvchilar matndagi yumshatuvchilarni topadi, ularni olib tashlab ta’sirini baholaydi va muqobil variant tuzadi; yumshatish nutq aktining yoqimsiz ta’sirini kamaytiruvchi vosita ekani yodda tutiladi [5]. Beshinchisi fikr-mulohaza va baholash: o‘qituvchi o‘quvchi javobining nafaqat grammatik to‘g‘riligini, balki vaziyatga mosligini ham baholaydi. Bu yo‘nalishlarni diskurs to‘ldirish vazifalari yordamida boshlang‘ich diagnostika sifatida ham qo‘llash mumkin.

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Dars ketma-ketligi sifatida quyidagi tartib taklif etiladi: avval o‘quvchilarga bitta vaziyatning ikki xil javobi (yumshatilmagan va yumshatilgan) taqdim etilib, ularning ta’siri muhokama qilinadi; so‘ng yumshatish vositalari tizimlashtiriladi (e’tirof, xejlash, shaxsiy fikr, muqobil taklif); keyin juftliklarda rol o‘yini o‘tkaziladi; oxirida o‘quvchilar o‘z javoblarini maqom o‘zgartirilgan vaziyatda qayta tuzadi. Bunday ketma-ketlik tushuntirishdan amaliy qo‘llashga bosqichma-bosqich o‘tish imkonini beradi. O‘qituvchi uchun muhim jihat shundaki, ona tilidagi to‘g‘ridan-to‘g‘rilikni xato deb baholash o‘rniga, uning ingliz tilida boshqacha qabul qilinishi mumkinligini tushuntirish kerak, chunki kelishmovchilikning talqini madaniy va vaziyatga bog‘liq [8]. Shuningdek, taklif etilgan yo‘nalishlarning samaradorligi haqida hozircha xulosa qilib bo‘lmaydi, buning uchun nazorat va tajriba guruhlari bilan o‘tkaziladigan tadqiqot zarur.

XULOSA

Maqolada kelishmovchilikni yumshatish ko‘nikmalarini shakllantirish pragmatik kompetensiyaning tarkibiy qismi sifatida ko‘rib chiqildi. Beshta ehtimoliy pragmatik qiyinchilik ajratildi: yumshatuvchisiz e’tiroz, e’tirofsiz *but*, so‘zma-so‘z ko‘chirish, qisman rozilik vositalarini bilmaslik va maqomga moslamaslik. Ularni bartaraf etish uchun chog‘ishtirma tahlil, kelishmovchilik gradatsiyasi, rol o‘yinlari, yumshatuvchilar ustida ishlash va vaziyatga mosligini baholash yo‘nalishlari taklif etildi. Misollar tuzilgani va yondashuvlar amaliyotda sinab ko‘rilmagani uchun xulosalar farazli xarakterga ega; kelgusida ularni sinf tajribasi va diskurs to‘ldirish testlari asosida tekshirish maqsadga muvofiq.

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BUGUNGI KUNDA O‘ZBEKISTONDA ARAB TILINI O‘QITISHDA “AL-MUFASSAL” TERMINOLOGIYASIDAN FOYDALANISHNING AHAMIYATI

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Annotatsiya. *Maqolada Mahmud az-Zamaxshariyning “Al-Mufassal fi san’at al-i’rob” asarida qo‘llangan grammatik terminlarning bugungi kunda O‘zbekistonda arab tilini o‘qitish jarayonidagi ilmiy-amaliy ahamiyati yoritiladi. Asardagi an’anaviy nahv va sarf tushunchalarini zamonaviy ta’lim mazmuniga uyg‘unlashtirish, arabcha terminlarni o‘zbekcha muqobillari bilan qiyosiy o‘rgatish hamda grammatik bilimlarni kommunikativ ko‘nikmalar bilan bog‘lash masalalari tahlil qilinadi. Shuningdek, terminologik izchillikni ta’minlash, o‘quvchilarda grammatik tafakkurni shakllantirish va tarixiy grammatik merosdan samarali foydalanish bo‘yicha metodik takliflar ilgari suriladi.*

Kalit so‘zlar: *al-Mufassal, Zamaxshariy, arab tili, grammatik terminologiya, nahv, sarf, termin, arab tilini o‘qitish, qiyosiy tahlil.*

Аннотация*. В статье рассматривается научно-практическое значение грамматической терминологии, использованной в труде Махмуда аз-Замахшари «Аль-Муфассал фи санаат аль-и‘раб», для преподавания арабского языка в современном Узбекистане. Анализируются возможности интеграции традиционных понятий нахва и сарфа в содержание обучения, сопоставительного изучения арабских терминов и их узбекских эквивалентов, а также связи грамматических знаний с коммуникативными навыками. Предлагаются методические подходы к обеспечению терминологической последовательности и развитию грамматического мышления обучающихся.*

Ключевые слова: *аль-Муфассал, аз-Замахшари, арабский язык, грамматическая терминология, нахв, сарф, термин, методика преподавания арабского языка, сопоставительный анализ.*

Abstract. *This paper examines the scholarly and practical value of the grammatical terminology used in Mahmud al-Zamakhshari’s Al-Mufassal fi ṣanʿat al-iʿrāb for teaching Arabic in contemporary Uzbekistan. It discusses how classical concepts of nahw and ṣarf can be integrated into modern curricula, how Arabic*

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grammatical terms can be taught alongside their Uzbek equivalents, and how explicit grammatical knowledge can support communicative competence. The paper also proposes methodological ways to promote terminological consistency, develop learners' grammatical awareness, and make effective use of the classical grammatical heritage.

Keywords: *Al-Mufassal, al-Zamakhshari, Arabic language, grammatical terminology, nahw, ṣarf, terminology, Arabic language teaching, contrastive analysis.*

KIRISH

Bugungi globallashuv sharoitida xorijiy tillarni, jumladan arab tilini o‘rganishga bo‘lgan ehtiyoj ta’lim, ilm-fan, xalqaro aloqalar, tarjima, turizm va madaniyatlararo muloqot sohalarida tobora ortib bormoqda. O‘zbekistonda arab tili oliy ta’lim muassasalarida sharq filologiyasi va tarjimashunoslik yo‘nalishlarida, shuningdek, turli ta’lim markazlari hamda mustaqil ta’lim tizimida o‘qitilmoqda. Bunday sharoitda tilni faqat kundalik muloqot vositasi sifatida emas, balki uning grammatik qurilishi, ilmiy istilohlari va tarixiy taraqqiyotini anglagan holda o‘rgatish ham muhimdir.

Chet tilini o‘qitishning asosiy maqsadlaridan biri o‘rganuvchida kundalik, akademik va kasbiy vaziyatlarda muloqot qila olish kompetensiyasini shakllantirishdir. Shu bilan birga, grammatik bilimlar kommunikativ faoliyatga xizmat qilishi, qoidalar esa matnni tushunish va mustaqil nutq yaratish bilan bog‘lanishi lozim. O‘zbekiston ta’lim tizimida chet tillar bo‘yicha kommunikativ kompetensiyaga yo‘naltirilgan yondashuvning belgilanishi ham mazkur masalaning dolzarbligini ko‘rsatadi [1].

AL-MUFASSAL ASARINING ILMIY-METODIK IMKONIYATLARI

Mahmud az-Zamaxshariyning (1075–1144) “Al-Mufassal fi san’at al-i’rob” asari arab grammatik tafakkuri tarixida muhim o‘rin tutadi. Asarda arab tilining morfologik va sintaktik hodisalari izchil tartibda bayon qilinib, grammatik tushunchalar aniq terminlar orqali ifodalangan. Asarning qadimiy nashrlari va keyingi sharhlari uning uzoq vaqt davomida ilmiy muomalada bo‘lganini tasdiqlaydi. Jumladan, Ibn Ya’ishning “Sharh al-Mufassal” asari Zamaxshariy qarashlarining keyingi grammatik an’anadagi sharh va talqinlarini o‘rganish uchun muhim manbadir [2; 3].

“Al-Mufassal” terminologiyasining muhim jihati shundaki, unda grammatik hodisalar alohida-alohida qoidalar sifatida emas, balki o‘zaro munosabatga kirishuvchi yaxlit tizim sifatida talqin qilinadi. Jumladan, اسم(ism), فعل(fe’l) va حرف (harf) kabi asosiy so‘z turkumlari, shuningdek, مبتدأ(mubtada), خبر(xabar), فاعل

(fo‘il), مفعول به(maf’ul bih), حال(hol), تمييز(tamyiz), نعت(na’t) kabi sintaktik terminlar gap tuzilishini anglashda muhim vosita bo‘la oladi. Fe’l tizimiga oid الماضي(o‘tgan zamon), المضارع(hozirgi-kelasi zamon), الأمر(buyruq) singari terminlar esa shakl, zamon va ma’no munosabatini tushuntirishga xizmat qiladi.

Zamaxshariy terminologiyasini o‘qitishda uning tarixiy manba ekanini hisobga olish zarur. Asardagi ayrim tushunchalar zamonaviy arab grammatikasi darsliklarida turlicha izohlanishi yoki o‘zbek tilshunosligidagi an’anaviy atamalar bilan to‘liq mos kelmasligi mumkin. Shu sababli terminlarni shunchaki yod oldirish emas, balki ularning ta’rifi, grammatik vazifasi, matndagi ko‘rinishi va boshqa terminlardan farqini ko‘rsatish maqsadga muvofiq. Zamaxshariyning “Al-Mufassal” asari zamonaviy arab grammatikasini o‘rganishda ham muhim nazariy manba sifatida tadqiq qilinmoqda [4; 5].

O‘QITISH JARAYONIDA TERMINOLOGIYADAN FOYDALANISH YO‘LLARI

Birinchidan, “Al-Mufassal” terminlarini bosqichma-bosqich o‘rgatish grammatik bilimlarning tizimliligini kuchaytiradi. Boshlang‘ich bosqichda اسم، فعل، حرفkabi tayanch birliklar, keyingi bosqichlarda esa إعراب(i’rob), بناء(bino), فاعل (fo‘il), مفعول به(maf’ul bih), مضاف ومضاف إليه(muzof va muzof ilayh) singari murakkabroq tushunchalarni kiritish mumkin. Har bir termin arab yozuvida, talaffuzi, o‘zbekcha izohi va sodda misoli bilan berilsa, o‘rganuvchi terminning shakli bilan birga uning vazifasini ham anglaydi.

Ikkinchidan, arabcha termin va o‘zbekcha grammatik atamani qiyoslash ikki til grammatik tizimlari o‘rtasidagi o‘xshash hamda farqli jihatlarni ko‘rishga yordam beradi. Masalan, فاعلatamasi ko‘pincha “ega” yoki “ish-harakat bajaruvchisi” tarzida izohlanadi. Biroq arab tilidagi فاعلtushunchasini o‘zbek tilidagi “ega” bilan har qanday holatda aynan tenglashtirish to‘g‘ri emas: arabcha فاعلfe’l bilan bog‘liq sintaktik munosabat va i’rob xususiyatlari orqali belgilanadi. Xuddi shuningdek, مفعول بهni faqat “to‘ldiruvchi” deb tarjima qilish uning arab sintaksisidagi aniq grammatik maqomini to‘liq ochib bermasligi mumkin. Demak, tarjima bilan birga funksional izoh ham berilishi kerak.

Uchinchidan, terminologiyani matn tahlili bilan bog‘lash samarali natija beradi. O‘qituvchi avval qisqa arabcha gap yoki matnni taqdim etadi, so‘ng undagi fe’l, bajaruvchi, to‘ldiruvchi va boshqa sintaktik birliklarni aniqlashni so‘raydi. Masalan, كَتَبَ الطَّالِبُ الدَّرْسَ(Talaba darsni yozdi) gapida كَتَبَ — فعل ماضٍ, الطَّالِبُ — فاعل, الدَّرْسَ — مفعول بهsifatida tahlil qilinadi. Bunday mashq terminni mavhum qoida sifatida emas, real nutqiy birlikni sharhlash vositasi sifatida o‘zlashtirishga imkon beradi.

To‘rtinchidan, terminologik kartochkalar, jadval, konseptual xarita, elektron lug‘at va interaktiv testlardan foydalanish mumkin. Har bir termin uchun to‘rtta

komponent — arabcha yozilishi, o‘qilishi, o‘zbekcha muqobili va kontekstual misol — yagona shaklda berilishi lozim. Bu usul turli darslik va o‘qituvchilar qo‘llayotgan atamalar o‘rtasidagi nomuvofiqlikni kamaytiradi. Shuningdek, talabalar terminlarni mustaqil ravishda izohlash, misol tuzish va matndan topish orqali faol o‘rganadilar.

Beshinchidan, terminlarni o‘rgatish o‘quvchining darajasiga moslashtirilishi kerak. Boshlang‘ich bosqichda terminlarning minimal to‘plami va sodda misollar yetarli bo‘lsa, o‘rta va yuqori bosqichlarda i’rob tahlili, grammatik qarashlarni qiyoslash, klassik matnlarni sharhlash hamda Zamaxshariy va keyingi grammatiklar qarashlarini taqqoslash topshiriqlarini kiritish mumkin. Shu tariqa “Al-Mufassal” terminologiyasi umumiy til kurslarida ham, filologik yo‘nalishdagi chuqurlashtirilgan mashg‘ulotlarda ham turli darajada qo‘llanishi mumkin.

XULOSA

Xulosa qilib aytganda, Mahmud az-Zamaxshariyning “Al-Mufassal” asaridagi grammatik terminologiyadan foydalanish O‘zbekistonda arab tilini o‘qitishning nazariy va amaliy imkoniyatlarini kengaytiradi. Mazkur terminlar arab tilining morfologik-sintaktik tizimini izchil anglash, grammatik hodisalarni nomlash va tahlil qilish, arabcha hamda o‘zbekcha grammatik tushunchalarni qiyoslash uchun mustahkam asos yaratadi. Biroq klassik terminologiyani zamonaviy ta’limga tatbiq etishda uning tarixiy xususiyatlarini hisobga olish, terminlarni zamonaviy darsliklardagi izohlar bilan solishtirish va o‘rganuvchining til darajasiga mos tanlash zarur.

Amaliy jihatdan quyidagi tavsiyalarni ilgari surish mumkin: 1) arab tili grammatikasi fanlari uchun “klassik arab grammatik terminlari” mavzuli glossariysini yaratish; 2) terminlarning arabcha shakli, o‘zbekcha izohi va kontekstual misolini birlashtirgan yagona jadvaldan foydalanish; 3) terminlarni matn o‘qish, tarjima va og‘zaki nutq mashqlari bilan uyg‘unlashtirish; 4) oliy ta’limda “Al-Mufassal”dan tanlangan parchalar asosida qiyosiy-grammatik tahlil mashg‘ulotlarini tashkil etish. Bu yondashuv tarixiy ilmiy merosni o‘quv jarayoniga mazmunli olib kirish bilan birga, arab tilini ongli va tizimli o‘zlashtirishga xizmat qiladi.

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COGNITIVE-SEMANTIC AND PRAGMATIC ASPECTS OF GASTRONOMIC IDIOMS IN ENGLISH

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Abstract. *This thesis examines English phraseological units with gastronomic components from semantic and pragmatic perspectives, drawing on both international and Uzbek linguistic scholarship. It shows that food-related idioms acquire figurative meaning through metaphor, metonymy and cultural symbolism, and that in discourse they perform expressive, evaluative, persuasive and interpersonal functions. The findings have practical implications for language teaching and for English–Uzbek translation.*

Keywords: *phraseological units; gastronomic components; semantics; pragmatics; metaphor; gluttonic discourse; cultural linguistics.*

Introduction

Phraseological units preserve cultural experience and offer insight into collective patterns of thought (Cowie, 1998; Kunin, 1996). In Uzbek linguistics, the formation of phraseological units has been studied in depth by A. E. Mamatov (1997), while the mechanisms of meaning transfer that underlie them, metaphor and metonymy among them, are described in M. T. Irisqulov’s (1992) introduction to linguistics.

Among the thematic groups of phraseology, expressions with gastronomic components are especially productive, since food is a universal part of human life. Food-related language has therefore become a research area of its own: G. Odilova (2023) treats gluttonic discourse, i.e. communication connected with food, as a reflection of a nation’s ethnic, religious and cultural outlook, and S. Saidakbarova (2019) has compared English and Uzbek food idioms in terms of equivalence. English idioms such as *spill the beans*, *take the cake*, *bad apple* and *salt of the earth* refer to food, yet their meanings describe character, emotions and social relations (Moon, 1998). The aim of this thesis is to outline the semantic mechanisms through which such units acquire figurative meaning and the pragmatic functions they perform in discourse.

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Materials and Methods

The material comprises commonly used English idioms with gastronomic components selected from phraseological dictionaries and corpus-based sources. Three qualitative methods were combined: componential analysis to relate literal and figurative meanings; cognitive-semantic analysis to reveal metaphorical and metonymic mappings (Lakoff & Johnson, 1980; Safarov, 2006); and pragmatic analysis to identify communicative functions such as evaluation, persuasion and emotional expression (Leech, 1983; Safarov, 2008). The units were then grouped by dominant semantic domain to identify recurring conceptual patterns.

Results and Discussion

The analysis revealed four major semantic groups of gastronomic phraseologisms.

Character and moral qualities. A *bad apple* is a dishonest or harmful person, the negative evaluation deriving from the image of one spoiled fruit damaging the healthy fruit around it. A *tough cookie* is a resilient person who is difficult to influence. In contrast, *salt of the earth* carries a strongly positive connotation: salt, historically valuable and essential, comes to stand for honesty, reliability and integrity.

Emotions. Taste is a productive source domain for emotional states. A *bitter truth* expresses disappointment or suffering, *sweet memories* evoke pleasure, and a *sour mood* signals irritation. Abstract emotional experience is thus understood through embodied sensory perception.

Thinking and communication. To *spill the beans* is to reveal a secret, a metaphorical extension from a physical action to a communicative act. *Use your noodle* urges someone to think carefully, while a *half-baked idea* is an immature or poorly developed concept.

Success and failure. *Sell like hotcakes* describes rapid commercial success, and *take the cake*, originally linked to winning a prize, marks something as the most remarkable. *Eat humble pie*, by contrast, means admitting an error and accepting humiliation.

Across all four groups, metaphor plays the central role: taste, food preparation and consumption serve as source domains for emotions, character, intellect and social relations, and familiar culinary scenes activate whole frames of background knowledge (Fillmore, 1982). This agrees with the cognitive view, developed in Uzbek linguistics by Sh. Safarov (2006), that language reflects the way human experience is conceptualised.

Pragmatically, gastronomic phraseologisms are multifunctional. They convey emotional attitudes, signal approval or disapproval, present arguments in vivid and

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memorable form, and create shared cultural ground between speaker and listener (Naciscione, 2010; Safarov, 2008). The same idiom may praise, criticise or warn depending on the speech act it serves (Searle, 1969), and as prefabricated formulaic sequences such units are quickly recognised by hearers (Wray, 2002). They are also frequent vehicles of irony: the exclamation *that takes the cake!* is usually positive in form but critical in intent. As Nurdinova and Egamnazarova (2022) show, irony is a multipurpose stylistic device whose interpretation depends on context and speech pragmatics.

The cultural dimension is equally significant. Bread, salt, apples, beans and cakes are not merely foodstuffs but cultural symbols, so interpreting these idioms requires cultural knowledge in addition to linguistic competence (Dobrovol'skij & Piirainen, 2005). This is consistent with Odilova's (2023) view that food-related communication is shaped by each nation's ethnic and religious worldview. For translation, comparative English–Uzbek research shows that food idioms range from full equivalents to units with no Uzbek counterpart (Saidakbarova, 2019), so translators and teachers must address figurative and cultural meaning, not only the literal one.

Conclusion

English phraseological units with gastronomic components derive their meanings through metaphor, metonymy and cultural symbolism and are used to conceptualise personality, emotions, cognition and social evaluation. In discourse they perform expressive, evaluative, persuasive and interpersonal functions, including ironic ones, and their communicative force stems from the interaction of semantic content and cultural knowledge. Further research may compare English gastronomic idioms with their Uzbek counterparts systematically, building on existing Uzbek studies of phraseology and food discourse, in order to distinguish universal from culture-specific patterns.

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ZOO-O‘XSHATISH VA PAREMIOLOGIYA

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Annotatsiya. *Maqolada o‘zbek tilidagi hayvon obraziga tayangan o‘xshatishlar bilan maqol va matallarning mazmuniy aloqalari o‘rganiladi. Sher, tulki, bo‘ri, quyon, qo‘y, ot hamda it nomlari qatnashgan nutq birliklari qiyosiy tahlil qilinadi. Obrazning baholovchi ma’nosi, gap tuzilishi va xalq tajribasi bilan aloqasi yoritiladi. Misollar orqali bir hayvon nomining turli nutq sharoitida turlicha ma’no olishi aniqlanadi. Tahlil zoonimlar orqali shakllangan xalqona tasavvurlarni izohlashga qaratilgan.*

Kalit so‘zlar*: zoo-o‘xshatish, paremiologiya, zoonim, maqol, matal, etalon, konnotatsiya.*

Abstract. *This paper examines semantic links between animal-based similes and Uzbek proverbs and sayings. Expressions involving lions, foxes, wolves, hares, sheep, horses, and dogs are compared through their imagery, evaluative meanings, and grammatical organization. The analysis explores how cultural associations shape interpretations and why one animal image may convey different judgments across contexts. Illustrative examples are interpreted qualitatively rather than treated as a representative corpus sample.*

Keywords*: animal simile, paremiology, zoonym, proverb, saying, comparison, connotation.*

Аннотация. *В статье рассматриваются семантические связи между сравнениями, основанными на образах животных, и узбекскими пословицами и поговорками. Проводится сопоставительный анализ речевых единиц с названиями льва, лисы, волка, зайца, овцы, лошади и собаки. Исследуются оценочные значения зооморфных образов, грамматическая структура выражений и их связь с народным опытом. На конкретных примерах выявляется способность одного и того же зоонима приобретать различные смысловые оттенки в зависимости от речевого контекста. Анализ направлен на интерпретацию традиционных народных представлений, закреплённых в языковых единицах с зоокомпонентами. Приведённые примеры рассматриваются с применением качественного анализа и не претендуют на*

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репрезентативность корпусной выборки.

***Ключевые слова**: зооморфное сравнение, паремиология, зооним, пословица, поговорка, эталон сравнения, коннотация.*

KIRISH

O‘zbek xalqining og‘zaki nutqida hayvon nomlari inson fe’l-atvorini, munosabatini va turmush tajribasini obrazli ifodalashga keng jalb etiladi. “Sherday botir”, “tulkiday ayyor”, “quyondek hurkak” singari o‘xshatishlarda hayvon muayyan belgi uchun qiyos mezoniga aylanadi. Maqol va matallarda ham jonivor obrazlari insoniy xatti-harakatlarga baho berish, ogohlantirish yoki hayotiy kuzatuvni umumlashtirish uchun qo‘llanadi. Ikki qatlam o‘rtasidagi yaqinlik tasodifiy emas: har ikkisi til jamoasining uzoq davom etgan kuzatuvlari va madaniy xotirasiga tayanadi.

Paremiologiya maqol, matal va ularga yaqin ixcham hikmatli birliklarni o‘rganadi. Zoo-o‘xshatish esa qiyos etaloni o‘rnida hayvon nomi kelgan ifodani anglatadi. Ikki hodisaning chegarasi doimo bir xil emas. O‘xshatish nutqda erkin yaratilishi mumkin; maqol odatda barqaror shaklga, tugallangan fikrga va umumlashtiruvchi mazmunga ega. Mukarramov (1976) va Qo‘ng‘urov (1977) o‘xshatishning ifoda imkoniyatlariga oid tadqiqotlari bilan tanilgan. Mahmudov va Xudoyberganova (2013) tuzgan izohli lug‘at esa qiyos obrazlarini o‘rganish uchun manbaviy tayanchdir. Tadqiqotning maqsadi hayvon obrazlarining mazkur ikki qatlamdagi vazifalarini qiyoslash, ularning o‘xshash va farqli jihatlarini til dalillari orqali tavsiflashdir.

TADQIQOT MATERIALLARI VA YONDASHUV

Tahlil uchun o‘zbek tilida tanish bo‘lgan o‘xshatishlar hamda xalq maqollarining ayrim namunalari tanlandi. Misollar izohiy tahlil uchun olingan; ular keng korpusdagi takrorlanish darajasi yoki hududiy tarqalish haqidagi statistik xulosaga asos bo‘la olmaydi. Maqol matnlarining yozilish variantlari mavjudligi ham e’tiborga olindi. Ishda tarkibiy tahlil, ma’no guruhlariga ajratish, kontekstual talqin va qiyoslash usullari qo‘llandi. Hayvon haqidagi xalqona tasavvur zoologik haqiqat bilan tenglashtirilmadi. O‘xshatishda qiyoslanayotgan shaxs yoki predmet, hayvon-etalon, umumiy belgi va grammatik vosita farqlanadi. “Yigit sherday botir” jumlasida yigit qiyos obyekti, sher etalon, botirlik qiyos belgisi, “-day” esa shakliy vositadir. “U sherday” jumlasida belgi ochiq aytilmaydi; tinglovchi uni oldingi gaplar yoki vaziyat orqali anglaydi. Maqolda esa obrazning vazifasi kengroq bo‘lib, biror turmushiy qoida yoki munosabatni ifodalashga yo‘naltiriladi.

ZOO-O‘XSHATISHLARNING MA’NO QATLAMLARI

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Sher obrazi ko‘pincha jasorat, kuch va qat’iyat bilan bog‘lanadi. “Sherday dadil” birikmasida qiyos ijobiy bahoga ega. Biroq obrazning bahosi yonidagi fe’l va sifatga ham bog‘liq. “Sherday o‘kirib yubordi” ifodasi kuchli ovozni tasvirlashi mumkin, ammo gapiruvchining munosabati vaziyatga qarab maqtov yoki tanqidga aylanishi ehtimoldan xoli emas. Birgina etalon har doim tayyor, o‘zgarmas ma’noni belgilamaydi. *Tulki obrazi* bilan bog‘langan “tulkiday ayyor” ifodasida aql va hiyla chegarasi seziladi. Ba’zi vaziyatlarda uddaburonlikka yaqin baho paydo bo‘ladi, boshqa vaziyatda esa ishonchsizlik ustun keladi. “Quyondek hurkak” iborasida qo‘rquv va tortinchoqlik, “qo‘ydek yuvosh” birikmasida muloyimlik yoki bo‘ysunuvchanlik ifodalanadi. Mazkur baholar insonning harakatiga, gapning ohangiga va muloqot qatnashchilarining tajribasiga bog‘liq. *Ot obrazi* mehnat, chidamlilik va jismoniy quvvat bilan yaqinlashadi. “Otday baquvvat” iborasi tananing kuchini ta’kidlaydi. “Kiyikdek yugurdi” ifodasida tezlik bilan yengillik birlashadi. Bo‘ri obrazi esa qat’iyat, tajovuz, ochko‘zlik yoki xavf bilan bog‘liq ma’nolarni olishi mumkin. “Bo‘ridek tashlandi” gapida hujumkor harakat, “bo‘ridek och” birikmasida kuchli ehtiyoj anglashiladi. Bahoning yo‘nalishi jonivor nomining o‘zidan ko‘ra butun birikma orqali yuzaga keladi.

PAREMIOLOGIK BIRLIKLARDA HAYVON OBRAZI

Maqollar alohida odamning bir martalik harakatini tasvirlashdan ko‘ra, umumiy tajribani ixcham ifodalashga moyil. “It hurar, karvon o‘tar” maqolida it obrazi tashqi to‘siq yoki behuda shovqinga, karvon esa o‘z yo‘lida davom etayotgan faoliyatga bog‘lanadi. Mazmunning markazida jonivorning tabiiy xulqi emas, insonning turli munosabatlarga qaramay ishini davom ettirishi turadi. Maqol tinglovchini vaziyatga baho berishga undaydi. “*Bo‘rining og‘zi yesa ham qon, yemasa ham qon*” maqolida bo‘ri oldindan shakllangan salbiy obro‘ bilan bog‘liq. Hikmatning mazmuni shaxs haqida mustahkamlangan gumon yoki yomon nomdan qutulish qiyinligiga borib taqaladi. “Bo‘ridek och” o‘xshatishi esa ayni obraz orqali ochlikning darajasini ifodalaydi. Ikkala nutq birligida ham bo‘ri qatnashadi, lekin ma’no qurilishi, gapning vazifasi va tinglovchiga ta’siri farqlanadi. “*Qarg‘a qarg‘aning ko‘zini cho‘qimaydi*” maqoli o‘zaro manfaat yoki guruh ichidagi birdamlik haqidagi tanqidiy mulohazani ifodalaydi. Qarg‘a nomi hayvonot olamiga oid aniq qonuniyatni tasdiqlamaydi; maqol ijtimoiy munosabatni obrazli tushuntiradi. “Qarg‘adek qag‘illadi” o‘xshatishida esa ovozning yoqimsizligi yoki takroriyligi oldinga chiqadi. Bitta zoonim ikki xil mazmuniy yo‘nalishda ishlaydi.

O‘XSHATISH VA MAQOL O‘RTASIDAGI FARQLAR

O‘xshatishning grammatik tuzilishi ko‘pincha “-day/-dek”, “kabi”, “singari” vositalari bilan belgilanadi. Maqolning tanilishi esa alohida qiyos qo‘shimchasiga bog‘liq emas. Unda gapning yaxlitligi, umumlashtirish xususiyati va xalq orasida

takrorlanishi asosiy o‘rinni egallaydi. “Tulki kabi ayyor” birikmasi ma’lum odamga nisbatan ishlatilishi mumkin; maqol esa muayyan vaziyatdan tashqarida ham hayotiy hukmni ifodalashga bo‘lgan mustaqil nutq birligidir.Mazkur birliklarning vaqtga munosabati ham turlicha. Erkin o‘xshatish ayni muloqotda yaratiladi va keyingi safar boshqa etalon bilan almashtirilishi mumkin. Maqolning so‘z tartibi va obrazlari nisbatan barqaror bo‘ladi. Almashtirish ko‘pincha tanish hikmatning ta’sirini susaytiradi yoki yangi kinoyaviy ma’no tug‘diradi. Shunga qaramay, maqollarning hududiy va og‘zaki variantlari uchrashi tabiiy hol. Barqarorlikni mutlaq o‘zgarmaslik deb tushunish to‘g‘ri emas.

O‘xshatishdagi baho ayrim paytda ochiq sifat bilan aytiladi: “quyondek qo‘rqoq”. Maqolda esa baho voqea yoki ikki obrazning munosabati ichiga singdiriladi. “It hurar, karvon o‘tar” gapida odamga bevosita “befoyda gapirma” deyilmaydi. Tinglovchi obrazlar o‘rtasidagi munosabatni o‘z holatiga ko‘chirib talqin qiladi. Paremiologik ifodaning ta’sirchanligi uning ixchamligi, ritmik tuzilishi va umumiy tajribaga tayanganligidan kelib chiqadi.

MADANIY TALQIN VA NUTQIY VAZIYAT

Hayvon obrazi bilan bog‘liq baholar xalqning xo‘jalik hayoti, tabiatni kuzatishi va og‘zaki ijod tajribasida shakllangan. Chorvachilikka oid ot, qo‘y, echki va bo‘ri obrazlari kundalik turmush bilan aloqador. Biroq madaniy obrazni barcha davr va barcha hudud uchun yagona deb qabul qilish ehtiyotkorlikni talab etadi. Bir joyda maqtovga yaqin tuyulgan ifoda boshqa muloqotda kinoya tusini olishi mumkin.Maqolni to‘g‘ri tushunish uchun kim gapirayotgani, kimga murojaat qilayotgani va qaysi voqea muhokama qilinayotganini bilish zarur. Masalan, “It hurar, karvon o‘tar” hikmati tanqidga e’tibor bermaslikka undovchi dalda bo‘lishi ham, asosli e’tirozni mensimaslikni oqlovchi ibora bo‘lishi ham mumkin. Nutqiy vaziyat mazmunning axloqiy yo‘nalishini o‘zgartiradi. Zoo-o‘xshatishlarda ham ayni qonuniyat kuzatiladi: “qo‘ydek yuvosh” mehr bilan aytilsa boshqa, masxara bilan aytilsa boshqa ohang oladi. Hayvonlar bilan bog‘liq tasavvurlarni tahlil etishda etalon, baho va kontekstni birgalikda o‘rganish foydali. Faqat zoonimning lug‘aviy izohi bilan cheklanish ko‘chma ma’noning nozik jihatlarini ochmaydi. O‘xshatishning tasviriy vazifasi bilan maqolning umumlashtiruvchi vazifasini ajratish esa paremiologik tahlilda tushunchalarning chalkashishiga yo‘l qo‘ymaydi. Har ikkala qatlam insonning tabiat haqidagi bilimidan ko‘ra uning tabiatga yuklagan madaniy ma’nolarini ham aks ettiradi.

O‘zbek tilidagi o‘xshatishlarni maqollar bilan solishtirganda obrazning matn ichidagi o‘rni alohida e’tiborni tortadi. “Tulkiday ayyor” birikmasi muayyan kishining xulqini ifodalaydi. Mazkur birikma ishtirok etgan gapni boshqa odamga moslab o‘zgartirish oson. Maqol tarkibidagi hayvon nomi esa butun hikmatning esda

qolishiga yordam beradi. Uning o‘rniga boshqa jonivor nomini qo‘yish odatiy talqinni buzishi mumkin. Til birligining qay darajada erkin yoki barqaror ekanini tekshirish uchun alohida matnlar, lug‘atlar va og‘zaki nutq yozuvlari zarur. O‘xshatish bilan maqolning yana bir aloqasi ularning tarbiyaviy nutqda qo‘llanishida ko‘rinadi. Kattalar bolaga “quyondek qo‘rqma” deb murojaat qilganda aniq xatti-harakatni o‘zgartirishni istaydi. Hikmatli ibora orqali esa vaziyatga umumiy munosabat bildiriladi. Hayvon obraziga murojaat qilish eshituvchining xotirasida jonli tasavvur uyg‘otadi. Lekin har bir obrazni axloqiy qoida deb qabul qilish ham xato: til stereotiplari tarixiy tajribadan tug‘ilgan bo‘lsa-da, ular inson xarakterini to‘liq tasniflay olmaydi.

Ilmiy tahlilda haqiqiy xalq maqoli bilan tadqiqotchi yaratgan misolni farqlash talab etiladi. “Sherday botir” singari qisqa qiyoslar nutqdagi namunaviy tuzilmani tasvirlaydi. “It hurar, karvon o‘tar” esa xalq orasida tanilgan paremiologik birlikdir. Qiyoslarning tarqalishi va maqollarning ishlatilish tezligi haqida qat’iy raqamlar chiqarish uchun tekshirilgan manbalar korpusi kerak. Hozirgi tavsif ma’no va tuzilishga doir sifatli kuzatish doirasida qoladi.

PAREMIOLOGIK OBRAZNING KOGNITIV ASOSI

Hayvon nomi ishtirokidagi obrazli birliklarda inson xulqi hayvonot olamiga oid tasavvurlar orqali anglanadi. Kognitiv metafora nazariyasida bir tajriba sohasi boshqa tajriba sohasi orqali talqin qilinishi izohlanadi (Lakoff & Johnson, 1980). “Tulkiday ayyor” birikmasida insonning murakkab ijtimoiy xulqi tulki haqidagi an’anaviy tasavvurga qiyoslanadi. “Bo‘rining og‘zi yesa ham qon, yemasa ham qon” maqolida esa hayvon obrazi shaxsning obro‘si va jamoaviy gumon bilan bog‘liq munosabatni ifodalaydi. Ikki misolning umumiy jihati obraz manbai, farqi esa mazmunning qamrovidir. Zoonimning ma’nosi faqat hayvon turiga bog‘lanmaydi. “Itday sodiq” va “itday xor” birikmalarida bir xil etalon qarama-qarshi baholarga ulanadi. Biroq mazkur misollar har bir hududda birdek qo‘llanishini tasdiqlamaydi. O‘xshatishning odatiyligi, maqolning qay darajada tanilganligi va ifodaning ijobiy yoki salbiy qabul qilinishi alohida dalillar bilan tekshirilishi lozim. Konseptual metafora va madaniy bilim o‘rtasidagi munosabatni o‘rganishda Kövecses (2010) ilgari surgan madaniy o‘zgaruvchanlik haqidagi qarashlar nazariy tayanch bo‘la oladi.

MAQOLNING PRAGMATIK VAZIFASI VA BAHO

Maqolning mazmuni lug‘aviy yig‘indidan kengroqdir. “It hurar, karvon o‘tar” gapining vazifasi faqat ikki obrazni qarama-qarshi qo‘yish emas; u muayyan muloqotda sabrga chaqirish, tanqidni rad etish yoki bahsni yakunlash maqsadida ishlatilishi mumkin. Paremiologik birlikning kim tomonidan, kimga va qanday

vaziyatda aytilgani talqinga ta’sir etadi. Mieder (2004) maqollarni tarixiy, madaniy va nutqiy muhit bilan bog‘liq holda o‘rganish zarurligini yoritadi.

“Qarg‘a qarg‘aning ko‘zini cho‘qimaydi” maqolida baho bevosita sifatlovchi orqali emas, obrazlar o‘rtasidagi munosabat orqali yetkaziladi. “Qarg‘adek qag‘illamoq” ifodasida esa qiyos tovush xususiyatiga yo‘naltiriladi. Maqol ijtimoiy xulq haqidagi umumiy hukmni, o‘xshatish ayrim shaxs yoki harakatning belgisini ajratadi. Ularni bir xil semantik birlik deb qarash nutqiy vazifalar orasidagi farqni xiralashtiradi.

TAHLIL MEZONLARI VA MANBANI TEKSHIRISH

Hayvon obrazlarini qiyoslash uchun besh mezon ajratildi: zoonimning lug‘aviy shakli, qiyos belgisi, baho yo‘nalishi, gapning kommunikativ vazifasi va matndagi barqarorlik darajasi. Masalan, “qo‘ydek yuvosh” birikmasida baho mehr yoki tanqidga moyil bo‘lishi mumkin; maqol tarkibidagi qo‘y obrazi esa boshqa hukm doirasida talqin qilinadi. Bu mezonlar tahlilni tartibga soladi, ammo keng matnlar to‘plamisiz statistik qonuniyat haqidagi da’voga asos bo‘lmaydi. Xalq maqolining aniq shakli lug‘at yoki folklor to‘plamidagi matn bilan solishtirilishi kerak. Og‘zaki variantlar mavjud bo‘lganda ularni xato shakl deb chiqarib tashlash emas, variantning manbasi va qo‘llanish hududini qayd etish ma’qul. Erkin tuzilgan o‘xshatishlar esa tasdiqlangan xalq maqoli deb taqdim etilmasligi zarur. Kelgusida maqollar va o‘xshatishlarni parallel jadvalga joylashtirish, har bir birlik uchun manba, kontekst, baho hamda variantni qayd qilish izlanishning tekshiriluvchanligini oshiradi.

XULOSA

Zoo-o‘xshatish va paremiologik birliklar hayvon nomlariga tayangan obrazli tafakkurning o‘zaro yaqin, ammo tuzilishi va nutqiy vazifasi farqli qatlamlaridir. O‘xshatishda alohida belgi qiyos orqali ochiladi; maqolda esa obraz ko‘pincha umumiy hayotiy hukmni ifodalaydi. Sher, bo‘ri, tulki, qo‘y va boshqa zoonimlarning bahosi bir xil qolmaydi: fe’l, kontekst va madaniy assotsiatsiya talqinga ta’sir etadi. Kelgusi izlanishlarda maqollar lug‘ati hamda matn korpusidan tuzilgan aniq tanlanma yordamida obrazlarning takrorlanishi va hududiy variantlarini tekshirish maqsadga muvofiq.

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10. 🎭 CULTURE, ARTS AND SPORT: NATIONAL HERITAGE, INTERNATIONAL EXPERIENCE AND INNOVATIVE DEVELOPMENT.

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YUQORI MALAKALI PARA TAEKVONDOCHILARNING FUNKSIYANAL TAYORGARLIK DINAMIKASI

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Annotatsiya: *Ushbu maqolada yuqori malakali para taekvondochilarning yillik tayyorgarlik siklidagi funksional tayyorgarlik dinamikasi ilmiy-nazariy va amaliy taraflari o‘rganib chiqilgan. Tadqiqot jarayonida sportchilarning organizmida roy beradigan fiziologik o‘zgarishlar, aerob va anaerob imkoniyatlarning rivojlanish bosqichlari hamda musobaqa shart-sharoitidagi energetik ta'minot mexanizmlari tahlil qilingan. Shuningdek, mashg‘ulot yuklamalarining hajmi va shiddatini o‘zgartirish orqali sportchilarning funksional ko‘rsatkichlarini boshqarish yo‘llari ko‘rsatib o‘tilgan va amaliy tavsiyalar ishlab chiqilgan.*

Kalit so‘zlar: *Para taekvondo, yuqori malakali sportchilar, funksional tayyorgarlik, dinamika, mashg‘ulot yuklamalari, jismoniy sifatlar, musobaqa faoliyati.*

Аннотация: *В данной статье научно-теоретически и практически исследована динамика функциональной подготовленности высококвалифицированных пара таэквондистов в годичном тренировочном цикле. В ходе исследования проанализированы физиологические изменения в организме спортсменов, этапы развития аэробных и анаэробных возможностей, а также механизмы энергообеспечения в соревновательных условиях. Кроме того, определены пути управления функциональными показателями спортсменов путем изменения объема и интенсивности тренировочных нагрузок, а также разработаны практические рекомендации.*

Ключевые слова: *Пара таэквондо, высококвалифицированные спортсмены, функциональная подготовленность, динамика, тренировочные нагрузки, физические качества, соревновательная деятельность.*

Abstract: *This article scientifically, theoretically, and practically examines the dynamics of the functional preparedness of highly qualified para-taekwondoin athletes within an annual training cycle. The study analyzes physiological changes within the athletes' bodies, the stages of development of aerobic and anaerobic capacities, and the mechanisms of energy supply under competitive conditions. Furthermore, ways to manage athletes' functional indicators by altering the volume*

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and intensity of training loads are identified, and practical recommendations are developed.

Keywords: *Para taekwondo, elite athletes, functional preparedness, dynamics, training loads, physical qualities, competitive activity.*

Kirish. Hozirgi kunda paralimpiya sporti, missal tariqasida aytib o‘tsak, para taekvondoning xalqaro nufuzi musobaqalar tobora ortib bormoqda. Tokio-2020 va Parij-2024 Yozgi Paralimpiya o‘yinlari dasturidan o‘rin olgan mazkur sport turida raqobatning ortishi sportchilarni tayyorlash tizimini ilmiy asosda takomillashtirishni taqozo etmoqda. Yuqori malakali para taekvondochilarning musobaqa faoliyati qisqa vaqt oralig‘ida yuqori shiddatli, portlovchi xarakterdagi texnik-taktik harakatlarni amalga oshirishni talab qiladi. Bu esa sportchilarning funksional tayyorgarlik darajasiga alohida talablar qo‘yadi. Ilmiy adabiyotlar tahlili shuni ko‘rsatadiki, sog‘lom taekvondochilarning jismoniy va funksional tayyorgarligi bo‘yicha ko‘plab tadqiqotlar o‘tkazilgan bo‘lsa-da, tayanch-harakat apparatida nuqsoni bo‘lgan yuqori malakali para taekvondochilarning yillik tayyorgarlik siklidagi funksional ko‘rsatkichlari dinamikasi yetarlicha o‘rganilmagan. Sportchining funksional zaxiralari, yurak-qon tomir va nafas olish tizimlarining yuklamalarga moslashuvchanligi hamda tiklanish jarayonlari tezligi musobaqadagi g‘alabani ta’minlovchi asosiy omillardan biridir.

Tadqiqotning maqsadi: Yuqori malakali para taekvondochilarning yillik tayyorgarlik bosqichlarida funksional tayyorgarlik dinamikasini o‘rganish va mashg‘ulot yuklamalarini optimallashtirish bo‘yicha amaliy tavsiyalar ishlab chiqish.

Tadqiqot vazifalari:

1. Yuqori malakali para taekvondochilarning musobaqa faoliyati xususiyatlaridan kelib chiqib, funksional tayyorgarlikning asosiy mezonlarini aniqlash.
2. Yillik tayyorgarlik siklining turli davrlarida (umumiy tayyorgarlik, maxsus tayyorgarlik va musobaqaoldi bosqichlarida) sportchilarning yurak-qon tomir tizimi hamda aerob-anaerob imkoniyatlari o‘zgarish dinamikasini tahlil qilish.
3. Olingan natijalar asosida mashg‘ulot jarayonini boshqarish samaradorligini oshirishga qaratilgan uslubiy tavsiyalar ishlab chiqish.

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Tadqiqot usullari va tashkil etilishi. Tadqiqot O‘zbekiston para taekvondo terma jamoasi a’zolari (K44 klassifikatsiyasi bo‘yicha xalqaro toifadagi sport ustalari va sport ustalari, n=14) ishtirokida yillik tayyorgarlik sikli davomida o‘tkazildi. Tadqiqotda quyidagi ilmiy-pedagogik va fiziologik usullardan foydalanildi:

Ilmiy-uslubiy adabiyotlarni tahlil qilish va umumlashtirish;

- **Pulsometriya va xronometraj:** Mashg‘ulot va nazorat janglari davomida yurak qisqarishlari soni (YQS) ko‘rsatkichlarini "Polar H10" datchiklari yordamida qayd etish;
- **Funksional sinovlar:** Rufye indeksi (yurak-qon tomir tizimining jismoniy yuklamaga moslashuvchanligini baholash), Shtange va Genchi sinovlari (gipoksiyaga chidamlilikni aniqlash), PWC170 testi (umumiy jismoniy ish qobiliyatini aniqlash);
- **Matematik-statistik tahlil:** Olingan raqamli ma’lumotlarning o‘rtacha arifmetik qiymati (X), standart og‘ishi (σ) va Styudent t-mezoni (p) bo‘yicha ishonchlilik darajasi hisoblandi.

Tadqiqot natijalari va ularning muhokamasi Yillik tayyorgarlik siklining uchta asosiy bosqichi — umumiy tayyorgarlik bosqichi (UTB), maxsus tayyorgarlik bosqichi (MTB) va musobaqaoldi bosqichi (MOB) yakunida o‘tkazilgan nazorat testlari para taekvondochilarning funksional holatida sezilarli ijobiy siljishlar yuz berganini ko‘rsatdi.

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Funksional ko‘rsatkichlar	Umumiy tayyorgarlik bosqichi ($X^{-}\pm\sigma$)	Maxsus tayyorgarlik bosqichi ($X^{-}\pm\sigma$)	Musobaqaoldi bosqichi ($X^{-}\pm\sigma$)	O‘sish dinamikasi (%)	Ishonchlilik darajasi (p)
Tinch holatdagi YQS (zarba/daq)	68,4±3,2	64,1 ±2,8	60,2 ±2,5	-11,9%	p < 0,01
Rufye indeksi (ball)	6,8 ±0,9	5,2±0,7	3,9±0,6	+42,6%	p < 0,01
Shtange sinovi (soniya)	54,2 ±4,5	62,8 ±4,1	71,5±3,8	+31,9%	p < 0,001
Genchi sinovi (soniya)	31,4 ±3,1	36,9 ±2,9	42,3±2,6	+34,7%	p < 0,001
PWC170 ko‘rsatkichi (kgm/daq/kg)	16,4 ±1,4	18,7 ± 1,2	20,5±1,1	+25,0%	p < 0,01
Nazorat jangidan keyingi 3-daqiqada YQS tiklanishi (zarba/daq)	134,5±5,4	122,0±4,8	112,4±4,2	+16,4%	p < 0,01

Tahlil natijalari:

Yurak-qon tomir tizimining tejamkorlashuvi: Umumiy tayyorgarlik bosqichida aerob yo‘nalishdagi (hajmli) mashg‘ulotlarning ustuvorligi hisobiga sportchilarning tinch holatdagi yurak urish chastotasi daqiqasiga 68,4 zarbadan musobaqaoldi bosqichida 60,2 zarbagacha pasaydi ($p < 0,01$). Bu miokardning kislorodga bo‘lgan ehtiyoji tejamkorlashganidan dalolat beradi.

Anaerob-glikolitik chidamlilikning o‘sishi: Para taekvondoda jang 5 daqiqa davom etishini (yoki 3 raundlik tizimda yuqori shiddatli almashinuvlarni) hisobga olsak, nafasni ushlab turish sinovlari (Shtange va Genchi) natijalarining mos ravishda 31,9% va 34,7% ga yaxshilanishi sportchilarning kislorod yetishmovchiligi (gipoksiya) sharoitida yuqori ish qobiliyatini saqlab qolish imkoniyati oshganini tasdiqlaydi.

Tiklanish jarayonlarining jadallashuvi: Musobaqa janglari orasidagi tanaffuslarda sportchining funksional holati qay darajada tez tiklanishi keyingi bellashuv natijasini belgilaydi. Maxsus tayyorgarlik va musobaqaoldi bosqichlarida

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intervalli-takroriy usulda o‘tkazilgan sparring mashg‘ulotlari natijasida jangdan keyingi 3-daqiqadagi YQS ko‘rsatkichi 134,5 zarbadan 112,4 zarbagacha tushdi.

K44 klassifikatsiyasi xususiyati: Yuqori kamari (qo‘l) amputatsiyasi yoki funksional cheklovi mavjud sportchilarda tana muvozanatini saqlash uchun korpus va oyoq mushaklariga tushadigan statik-dinamik yuklama sog‘lom sportchilarnikiga nisbatan 12–15\% ga yuqori bo‘ladi. Shu sababli, mashg‘ulotlarning maxsus bosqichida korpus barqarorligi (core stability) va anaerob quvvatni rivojlantiruvchi mashqlar ulushini oshirish PWC170 ko‘rsatkichining 25,0% ga o‘sishiga zamin yaratdi.

Xulosa va amaliy tavsiyalar

Yuqori malakali para taekvondochilarning funksional tayyorgarlik dinamikasi yillik sikl davomida to‘lqinsimon xarakterga ega bo‘lib, umumiy tayyorgarlik bosqichida aerob bazani shakllantirish, musobaqaoldi bosqichida esa anaerob-glikolitik va alaktat quvvatni maksimal darajaga olib chiqish orqali yuqori sport formasiga erishiladi.

Funksional holatni nazorat qilishda nafaqat mashg‘ulot vaqtidagi maksimal puls ko‘rsatkichlariga, balki yuklamadan keyingi 1- va 3-daqiqalardagi YQS ning tiklanish tezligiga asosiy e’tibor qaratish lozim.

Amaliy tavsiya: Murabbiylar K44 klassifikatsiyasidagi sportchilar uchun mashg‘ulot rejasini tuzishda tayanch-harakat apparatidagi assimetriyani hisobga olgan holda, yuklama hajmi va shiddatini individual pulsometrik zonalar (165–185 zarba/daq oralig‘idagi maxsus ishchi zona) asosida me’yorlashtirishlari tavsiya etiladi.

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BO‘LAJAK PEDAGOGLARNING JISMONIY FAOLLIGINI OSHIRISH — SOG‘LOM TURMUSH TARZIGA TAYYORLASHNING TASHKILIY-FAOLIYATLI MEXANIZMI SIFATIDA

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Annotatsiya. *Tezisda pedagogika yo‘nalishi talabalarini sog‘lom turmush tarziga tayyorlash tizimida jismoniy faollikni oshirishning tashkiliy-faoliyatli mexanizmi tavsiflanadi. Uch oliy ta’lim muassasasida 428 nafar talaba ishtirokida o‘tkazilgan tajriba-sinov asosida sport seksiyalari jadvalini dars jadvaliga moslashtirish, boshlang‘ich daraja guruhlari, «Qadamlar marafoni» va talaba-volontyorlar guruhi kabi shakllarning samaradorligi ko‘rsatiladi: seksiyalarga muntazam qatnashuvchilar ulushi 31,3 foizdan 58,4 foizga o‘sdi, faolligi past deb topilib yo‘naltirilgan talabalarning 73,1 foizi haftalik me’yorga erishdi.*

Kalit so‘zlar: *jismoniy faollik, sog‘lom turmush tarzi, bo‘lajak pedagog, sport seksiyalari, tashkiliy-faoliyatli mexanizm, oliy ta’lim.*

Аннотация. *В тезисах описан организационно-деятельностный механизм повышения физической активности в системе подготовки студентов педагогических направлений к здоровому образу жизни. На основе опытно-экспериментальной работы с участием 428 студентов трёх вузов показана эффективность таких форм, как согласование расписания спортивных секций с учебным расписанием, группы начального уровня, «Марафон шагов» и группа студентов-волонтёров: доля регулярно посещающих секции выросла с 31,3 % до 58,4 %, 73,1 % направленных студентов с низкой активностью достигли недельной нормы.*

Ключевые слова: *физическая активность, здоровый образ жизни, будущий педагог, спортивные секции, организационно-деятельностный механизм, высшее образование.*

Abstract. *The paper describes the organisational-activity mechanism for increasing physical activity within the system of preparing pedagogy students for a healthy lifestyle. Based on experimental work with 428 students at three universities, it shows the effectiveness of such forms as aligning sports-section timetables with*

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class schedules, beginner-level groups, the "Step Marathon" and a student-volunteer group: the share of regular section attendees rose from 31.3% to 58.4%, and 73.1% of referred low-activity students reached the weekly norm.

Keywords: *physical activity, healthy lifestyle, future teacher, sports sections, organisational-activity mechanism, higher education.*

Kirish. Bo‘lajak pedagog uchun jismoniy faollik shaxsiy masala emas: o‘qituvchi o‘quvchilar uchun turmush tarzi namunasi bo‘lib, maktabda faol tanaffuslar, jismoniy tarbiya daqiqalari va sport-sog‘lomlashtirish tadbirlarini tashkil etadi. Biroq kirish diagnostikasi pedagogika yo‘nalishi talabalarining 63,3 foizi haftasiga 150 daqiqalik me’yordan [3] kam harakatlanishini, sport seksiyalariga muntazam qatnashuvchilar atigi 31,3 foizni tashkil etishini ko‘rsatdi [1]. To‘siqlar orasida talabalar sport inshootlaridagi navbatni va seksiyalar jadvalining dars jadvali bilan to‘qnashuvini ko‘rsatdi — ya’ni motivatsiyaga emas, tashkiliy sharoitga bog‘liq omillarni. Tadqiqotning maqsadi — sog‘lom turmush tarziga tayyorlash tizimida jismoniy faollikni oshirishning tashkiliy-faoliyatli mexanizmini ishlab chiqish va sinovdan o‘tkazish.

Asosiy qism. Tadqiqotda talabalarni sog‘lom turmush tarziga tayyorlash to‘rt o‘zaro bog‘liq pedagogik mexanizm — motivatsion-targ‘ibot, mazmuniy-integrativ, tashkiliy-faoliyatli va diagnostik-korreksion — tizimi sifatida loyihalandi [1]. Tashkiliy-faoliyatli mexanizmning funksional vazifasi bilimni xulq-atvorga aylantirish bo‘lib, u faoliyat nazariyasi va salomatlikning ekologik modellariga tayanadi [2]. Tajriba-sinov ishlari 2023–2026-yillarda uch oliy ta’lim muassasasida 428 nafar talaba (tajriba va nazorat guruhlarida 214 nafardan) ishtirokida o‘tkazildi.

Mexanizm doirasida jismoniy faollikni oshirishning quyidagi shakllari joriy etildi. *Seksiyalar jadvalini moslashtirish:* oraliq diagnostika jadval to‘qnashuvi asosiy to‘siq ekanini tasdiqlagach, sport klubi va jismoniy tarbiya kafedrasi bilan birgalikda seksiyalarning ish vaqti talabalarning bo‘sh soatlariga ko‘chirildi — bu kam xarajatli, ammo eng ko‘rinarli o‘zgarish bo‘ldi. *Boshlang‘ich daraja guruhlari:* bir guruhda ham sportchi, ham umuman harakat qilmaydigan talaba bo‘lgani uchun faolligi past talabalar uchun bosqichma-bosqich yuklama rejasi bilan alohida mashg‘ulotlar tashkil etildi; yutuq mutlaq ko‘rsatkich bilan emas, shaxsiy dinamika bilan o‘lchandi. *«Qadamlar marafoni»:* guruhlararo chellenj davrida o‘rtacha kunlik qadamlar soni 5 400 dan 8 900 gacha ko‘tarildi, chellenjdan so‘ng 7 600 darajasida saqlanib qoldi — gamifikatsiya ta’siri qisman barqaror. *Talaba-volontyorlar guruhi:* tengdoshlar ta’limi tamoyilida ishlab, guruhdagi ijtimoiy me’yorni o‘zgartirdi — sog‘lom xulq-atvor «g‘ayrioddiy» emas, «odatiy va hurmatga sazovor» holga keldi. *Kasbiy komponent:* pedagogik amaliyot davrida har bir talaba o‘quvchilar uchun

sog‘lom turmush tarzi mavzusida tadbir loyihalab o‘tkazdi; ekspert baholashida tadbirlarning 78,5 foizi «yaxshi» va «a’lo» deb topildi [1].

Natijalar: tajriba guruhida sport seksiyalariga muntazam qatnashuvchilar ulushi 31,3 foizdan 58,4 foizga o‘sdi; oraliq diagnostikada jismoniy faolligi past deb topilib, seksiyalarga yo‘naltirilgan 52 nafar talabaning 38 nafari (73,1 foiz) semestr oxirida haftalik me’yorga erishdi; valeologik kompetentlikning integral ko‘rsatkichi tajriba guruhida 56,2 dan 74,8 ballga o‘sdi (nazorat guruhida 56,6 dan 68,9 ga), guruhlararo farq statistik ahamiyatli ($t = 5,17$; $p < 0,05$) [1]. Shu bilan birga, natijalar yaxlit tizimning samarasi bo‘lib, tashkiliy-faoliyatli mexanizmning alohida hissasini ajratib bo‘lmaydi — bu tadqiqotning cheklovidir.

Xulosa. Bo‘lajak pedagoglarning jismoniy faolligiga to‘sqinlik qiluvchi asosiy omillar tashkiliy xarakterga ega va tashkiliy yechim bilan bartaraf etiladi. Seksiyalar jadvalini moslashtirish, boshlang‘ich daraja guruhlari, guruhiy chellenj va tengdoshlar ta’limi qo‘shimcha resurs talab qilmaydi va har qanday pedagogika oliy ta’lim muassasasida qo‘llanishi mumkin va «O‘zbekiston – 2030» strategiyasida belgilangan sog‘lom turmush tarzini targ‘ib qilish vazifasiga [4] xizmat qiladi. Jismoniy faollik kasbiy kontekst — o‘quvchilar uchun tadbir o‘tkazish — bilan bog‘langanda talaba uchun yangi ma’no kasb etadi va sog‘lom turmush tarziga tayyorlashning barqaror natijasiga aylanadi.

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SPORT MAKTABLARIDA TARBIYALANUVCHI PARA TAEKVANDOCHILARDA MUVOZANAT VA KOORDINATSION QOBILIYATLARNI RIVOJLANTIRISH

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Annotatsiya. *Ushbumaqolada sport maktablarida tarbiyalanuvchi yosh para taekvondochilarning muvozanat saqlash, koordinatsion qobiliyatlarini rivojlantirish metodikasi ilmiy-nazariy va amaliy xususiyatlari keltirilgan. Yuqori kamari funksiyasida nuqsoni bo'lgan sportchilarda tana og'irlik markazi siljishi va harakat assimetriyasini kompensatsiya qilishga qaratilgan maxsus mashqlar majmuasi ishlab chiqilgan. Pedagogik tajriba davomida statik va dinamik muvozanat hamda vestibulyar barqarorlik ko'rsatkichlarining o'sish dinamikasi tahlil qilingan.*

Kalit so'zlar: *Sport maktabi, para taekvondo, muvozanat, koordinatsion qobiliyatlar, tayanch-harakat apparati, tana og'irlik markazi, mashg'ulot metodikasi.*

Аннотация: *В данной статье научно-теоретически и практически освещена методика развития равновесия и координационных способностей у юных пара таэквондистов, занимающихся в спортивных школах. Разработан комплекс специальных упражнений, направленный на компенсацию смещения центра тяжести тела и двигательной асимметрии у спортсменов с поражением верхних конечностей. В ходе педагогического эксперимента проанализирована динамика роста показателей статического и динамического равновесия, а также вестибулярной устойчивости.*

Ключевые слова: *Спортивная школа, пара таэквондо, равновесие, координационные способности, опорно-двигательный аппарат, центр тяжести тела, методика тренировки.*

Abstract: *This article scientifically, theoretically, and practically highlights the methodology for developing balance and coordination abilities in young para-taekwondo athletes training in sports schools. A set of special exercises aimed at compensating for the displacement of the body's center of gravity and motor asymmetry in athletes with upper limb impairments has been developed. During the pedagogical experiment, the growth dynamics of static and dynamic balance indicators, as well as vestibular stability, were analyzed.*

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Keywords: *Sports school, para taekwondo, balance, coordination abilities, musculoskeletal system, center of gravity, training methodology.*

KIRISH

Respublikamizda paralimpiya sport turlarini ommalashtirish va sport maktablarida imkoniyati cheklangan yoshlar uchun zamonaviy shart-sharoitlar yaratish davlat siyosati darajasiga ko‘tarilgan. Xususan, para taekvondo sport turida yuqori natijalarga erishish poydevori aynan sport maktablaridagi boshlang‘ich va o‘quv-mashq guruhlarida qo‘yiladi. Para taekvondoda texnik harakatlar faqat oyoq zarbalari (korpusga beriladigan zarbalar) orqali baholanishi va qo‘l harakatlarining cheklanganligi (amputatsiya yoki tug‘ma nuqsonlar sababli) sportchi biomekanikasiga jiddiy ta’sir ko‘rsatadi. Sog‘lom taekvondochilar zarba berish vaqtida qo‘llarining qarama-qarshi harakati (inersiuchi muvozanat) hisobiga tana barqarorligini ta’minlasalar, para taekvondochilarda ushbu kompensator mexanizm cheklangan bo‘ladi. Natijada, bir oyoqda turib murakkab zarbalar (masalan, *dollyo-chagi*, *yop-chagi*, *dvi-chagi*) berishda tana og‘irlik markazi (TOM) og‘ib ketishi, muvozanat yo‘qolishi va texnik xatolarga yo‘l qo‘yish holatlari ko‘p kuzatiladi. Shu bois, sport maktabi tarbiyalanuvchilarida muvozanat va koordinatsion qobiliyatlarni maqsadli rivojlantirish dolzarb ilmiy-pedagogik muammo hisoblanadi.

TADQIQOT MAQSADI

Sport maktablarida tarbiyalanuvchi yosh para taekvondochilarning muvozanat, koordinatsion qobiliyatlarini rivojlantirishga qaratilgan maxsus mashqlar majmuasini ishlab chiqish va uning samaradorligini tajribada asoslash.

Tadqiqot usullari va tashkil etilishi:

Pedagogik tajriba sport maktabining o‘quv-mashq guruhida shug‘ullanuvchi 12–15 yoshli (K44 klassifikatsiyasiga mansub) 16 nafar yosh para taekvondochilar ishtirokida 6 oy davomida o‘tkazildi. Sportchilar teng tarkibli nazorat (n=8) va tajriba (n=8) guruhlariga ajratildi.

Nazorat guruhi amaldagi standart o‘quv dasturi asosida shug‘ullangan bo‘lsa, tajriba guruhi mashg‘ulotlarining tayyorgarlik va asosiy qismlariga haftasiga 3 marta (20–25 daqiqadan) maxsus vestibulyar, proprioseptiv (nostabil tayanch yuzalarida) va korpus barqarorligini oshiruvchi koordinatsion mashqlar kiritildi.

Nazorat testlari sifatida quyidagilar qo‘llanildi:

1. **Romberg sinovi (murakkablashtirilgan varianti):** Bir oyoqda, ko‘zlar yumilgan holda muvozanat saqlash vaqti (soniya).
2. **Yarotskiy sinovi:** Boshni uzluksiz aylantirish davomida muvozanatni saqlab turish vaqti — vestibulyar analizator barqarorligini baholash (soniya).

3. **"Chumchuq" (yoki *ap-chagi* holatida ushlab turish) maxsus testi:** Zarba beruvchi oyoqni tizzadan bukib, ko‘krak balandligida maksimal vaqt davomida muvozanatni yo‘qotmasdan ushlab turish (soniya).

4. **Tezkor-koordinatsion harakat testi (3x10 m mokisimon yugurish va burilishlar):** Fazoviy mo‘ljal olish va harakat yo‘nalishini tez o‘zgartirish qobiliyati (soniya).

Tadqiqot natijalari va ularning muhokamasi

Tajriba yakunida olingan natijalar shuni ko‘rsatdiki, tajriba guruhi sportchilarida muvozanat va koordinatsion ko‘rsatkichlar nazorat guruhiga nisbatan ishonchli darajada ($p < 0,05$ va $p < 0,01$) yuqori sur’atlarda o‘sgan.

1-jadval

Nazorat testlari	Guruhlar	Tajriba boshida ($X^{-}\pm\sigma$)	Tajriba oxirida ($X^{-}\pm\sigma$)	O‘sish farqi (birlik)	O‘sish (%)	p
Romberg sinovi (soniya)	NG (n=8)	14,±21,8	16,5±1,9	+2,3	16,2%	> 0,05
	TG (n=8)	14,0±1,7	21,8±2,1	+7,8	55,7%	< 0,01
Yarotskiy sinovi (soniya)	TG (n=8)	14,0±1,7	21,8±2,1	+7,8	55,7%	< 0,01
	NG (n=8)	18,4±2,2	21,1±2,3	+2,7	14,7%	> 0,05
Maxsus zarba holatini ushlab turish (soniya)	NG (n=8)	11,5±1,5	14,2±1,6	+2,7	23,5%	< 0,05
	TG (n=8)	11,3±1,4	19,6±1,8	+8,3	73,4%	< 0,001
Mokisimon yugurish 3x10 m (soniya)	NG (n=8)	9,42±0,35	9,15±0,31	-0,27	2,9%	> 0,05
	TG (n=8)	9,45±0,34	8,64±0,26	-0,81	8,6%	< 0,05

OLINGAN NATIJALAR TAHLILI

Proprioseptiv sezgirlikning ortishi: Bosu yarim sharlari va muvozanat yostiqchalarida (balance pad) bajarilgan texnik harakatlar tayanch oyoqning boldir-tovon bo‘g‘imi barqarorligini mustahkamladi. Natijada, TG sportchilarida Romberg sinovi ko‘rsatkichi 55,7% ga, maxsus zarba holatini ushlab turish ko‘rsatkichi esa 73,4% ga yaxshilandi.

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Assimetriyani kompensatsiya qilish: Bir qo‘li yo‘q yoki funksiyasi cheklangan yosh sportchilarda tana burilishlari (masalan, *dvi-chagi* zarbasida 180 va 360ga aylanish) vaqtida vestibulyar apparatga tushadigan yuklama yuqori bo‘ladi. Ko‘zlarni yumgan holda bajarilgan maxsus koordinatsion mashqlar ko‘rish analizatori nazoratini cheklab, mushak-bo‘g‘im sezgirligini (kinestetik nazorat) faollashtirdi.

Texnik aniqlikka ta’siri: Dinamik muvozanatning yaxshilanishi sportchilarga zarba bergandan so‘ng jangovar turish holatiga (stoykaga) ortiqcha qadamlarsiz, tez va barqaror qaytish imkonini berdi, bu esa musobaqa bellashuvlarida qarshi hujumlardan himoyalanish samaradorligini oshirdi.

XULOSA VA AMALIY TAVSIYALAR

Sport maktablarida tarbiyalanuvchi para taekvondochilarda tayanch-harakat apparati nuqsoni tufayli yuzaga keladigan tana og‘irlik markazi assimetriyasini bartaraf etish uchun boshlang‘ich tayyorgarlik bosqichidanoq muvozanat va koordinatsion mashqlarga ustuvor ahamiyat berish zarur.

Tajriba guruhida qo‘llanilgan nostabil tayanch yuzalaridagi mashqlar va korpusning chuqur mushaklarini (core) mustahkamlash metodikasi statik muvozanatni 55,7% ga, maxsus dinamik barqarorlikni esa 73,4% ga oshirish imkonini berdi.

Murabbiylar uchun amaliy tavsiyalar: Mashg‘ulotlarda zarba texnikasini o‘rgatishda avval barqaror yuzada (dayang), so‘ngra yumshoq matlar va muvozanat yostiqchalarida bajarish ketma-ketligiga (oddiydan murakkabga tamoyili) rioya qilish; Har bir mashg‘ulotning yakunlovchi qismida 5–7 daqiqa davomida ko‘zlar yumilgan holda statik muvozanat saqlash va vestibulyar apparatni chiniqtiruvchi burilish mashqlarini muntazam qo‘llash tavsiya etiladi.

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O‘QUV MASHG‘ULOTI TUZILMASIGA SINGDIRILGAN MIKROFAOLLIK PAUZALARI — TALABALAR JISMONIY FAOLLIGINI RIVOJLANTIRISHNING INNOVATSION SHAKLI

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Annotatsiya. *Tezisda talabalar jismoniy faolligini o‘quv jarayonining o‘ziga singdirish g‘oyasiga asoslangan mikrofaollik texnologiyasi tavsiflanadi: o‘quv jadvalidagi «faollik uzilishlari»ni aniqlash algoritmi, mashg‘ulot bosqichlari chegarasiga joylashtiriladigan uch turdagi pauza (gigiyenik-tiklovchi, kognitiv-faollashtiruvchi, kasbiy-metodik) va «faollik kartochkalari» banki. Uch oliy ta’lim muassasasida 412 nafar talaba ishtirokidagi tajribada harakat pauzali mashg‘ulotlar ulushi 7,3 foizdan 78,6 foizga, eng uzun uzluksiz o‘tirish davomiyligi 175 daqiqadan 108 daqiqaga o‘zgardi; nazorat guruhida bu ko‘rsatkichlar deyarli o‘zgarmadi.*

Kalit so‘zlar: *jismoniy faollik, mikrofaollik pauzasi, o‘tirg‘ich xulq-atvor, faollik uzilishi, faollik kartochkalari, talaba, pedagogika yo‘nalishi.*

Аннотация. *В тезисах описана технология микроактивности, основанная на идее встраивания физической активности студентов в сам учебный процесс: алгоритм выявления «разрывов активности» в расписании, три типа пауз (гигиенически-восстановительные, когнитивно-активизирующие, профессионально-методические), размещаемых на границах этапов занятия, и банк «карточек активности». В эксперименте с участием 412 студентов трёх вузов доля занятий с двигательными паузами выросла с 7,3 % до 78,6 %, максимальная продолжительность непрерывного сидения сократилась со 175 до 108 минут; в контрольной группе показатели практически не изменились.*

Ключевые слова: *физическая активность, пауза микроактивности, сидячее поведение, разрыв активности, карточки активности, студент, педагогическое направление.*

Abstract. *The paper describes a micro-activity technology based on embedding students’ physical activity into the learning process itself: an algorithm for*

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identifying "activity gaps" in the timetable, three types of pauses (hygienic-restorative, cognitive-activating, professional-methodical) placed at the boundaries of lesson stages, and a bank of "activity cards". In an experiment with 412 students at three universities, the share of lessons with movement pauses rose from 7.3% to 78.6%, and the longest continuous sitting bout fell from 175 to 108 minutes; in the control group these indicators remained practically unchanged.

Keywords: *physical activity, micro-activity pause, sedentary behaviour, activity gap, activity cards, student, pedagogy programme.*

Kirish. Talabalar jismoniy faolligini oshirishning an'anaviy yo‘li — sport seksiyalari va musobaqalar — faqat qiziquvchi talabalarni qamrab oladi, o‘quv kunining asosiy qismi esa o‘tirgan holda o‘tadi. Kirish diagnostikasi pedagogika yo‘nalishi talabalarining 61,4 foizida eng uzun uzluksiz o‘tirish davomiyligi 3 soatdan ortiq ekanini, kuzatilgan 96 ta mashg‘ulotdan atigi 7 tasida (7,3 foiz) harakat pauzasi o‘tkazilganini ko‘rsatdi [1]. Jahon sog‘liqni saqlash tashkiloti tavsiyalari uzoq o‘tirishni har qanday jadallikdagi harakat bilan uzib turishni alohida talab sifatida belgilaydi [2]. Demak, masala qo‘shimcha mashg‘ulot qo‘shishda emas, mavjud mashg‘ulotning o‘zini harakatli qilishda. Tadqiqotning maqsadi — o‘quv mashg‘uloti tuzilmasiga singdirilgan mikrofaollik texnologiyasini ishlab chiqish va samaradorligini tekshirish.

Asosiy qism. Texnologiya uch elementdan iborat. *Birinchisi — «faollik uzilishlari»ni aniqlash algoritmi.* Faollik uzilishi deganda talabaning uzluksiz o‘tirish davomiyligi 60 daqiqadan oshadigan vaqt oralig‘i tushuniladi. Besh qadamli algoritm bo‘yicha talabaning haftalik harakat profili (smartfon qadam hisoblagichi va «Faollik kundaligi» orqali) dars jadvali bilan taqqoslanadi, uzilishlar — odatda 2–4 soatlik ketma-ket mashg‘ulotlar va kechki mustaqil ish davri — aniqlanadi va har biri uchun to‘ldirish varianti tanlanadi: mashg‘ulot ichidagi pauza, tanaffusdagi faol harakat, binolar orasidagi yo‘lni piyoda bosib o‘tish, mustaqil ish davrida «45+5» rejimi [1].

Ikkinchisi — mashg‘ulot tuzilmasiga singdirilgan pauzalar. Didaktikada mashg‘ulot bosqichlar ketma-ketligi sifatida qaraladi; pauza istalgan joyga emas, faoliyat turi almashinadigan bosqichlar chegarasiga qo‘yiladi, aks holda u o‘quv mantiqini buzadi. Uch turdagi pauza ishlab chiqildi: *gigiyenik-tiklovchi* (2–3 daqiqa: ko‘z, bo‘yin, umurtqa uchun mashqlar, turgan holda cho‘zilish), *kognitiv-faollashtiruvchi* (harakat bilan birga o‘quv topshirig‘i: «rozi bo‘lsang — tur», burchaklar bo‘yicha javob tanlash, harakatli takrorlash) va *kasbiy-metodik* (pedagogika yo‘nalishi talabasi pauzani o‘zi o‘tkazadi va bu uning bo‘lajak kasbiy

ko‘nikmasi hisoblanadi). Tajribada pauzalarni o‘tkazish ko‘nikmasi to‘rt bosqichda — kuzatuvchi, takrorlovchi, moslashtiruvchi, ijodiy — shakllanishi kuzatildi [1].

Uchinchisi — «faollik kartochkalari» banki. 60 dan ortiq kartochka yaratildi; har birida maqsad, davomiylik, mashqlar tavsifi, xavfsizlik eslatmasi va salomatlik cheklovi bo‘lgan talabalar uchun moslashtirilgan variant ko‘rsatilgan. Kartochkalar LMS-kursda joylashtirilib, o‘qituvchi va «faollik navbatchisi» talaba uchun tayyor vosita bo‘lib xizmat qildi. Masofaviy mashg‘ulotda pauza o‘qituvchi tomonidan e’lon qilinadi va kamerani yoqmasdan bajarish imkoniyati beriladi.

Texnologiya 2024–2026-yillarda uch oliy ta’lim muassasasida 412 nafar talaba (tajriba va nazorat guruhlarida 206 nafardan) ishtirokida sinovdan o‘tkazildi. Tajriba guruhida harakat pauzali mashg‘ulotlar ulushi 7,3 foizdan 78,6 foizga o‘sdi (nazorat guruhida 7,1 dan 9,7 foizga); eng uzun uzluksiz o‘tirish davomiyligi 175 daqiqadan 108 daqiqaga qisqardi (nazorat guruhida 178 dan 166 ga); farq statistik ahamiyatli (t = 8,72; $p < 0,001$) [1]. Nazorat guruhida o‘tirish davomiyligi va pauzalar bo‘yicha ko‘rsatkichlar deyarli o‘zgarmagani ularning tabiiy ravishda emas, faqat maqsadli pedagogik aralashuv orqali o‘zgarishini ko‘rsatadi. Yakuniy so‘rovda talabalarning 31,6 foizi mikrofaollik pauzalarini metodikaning eng foydali elementi deb ko‘rsatdi; ochiq javoblarda «pauzalar dastlab g‘alati tuyuldi, keyin yoqib qoldi» va «maktab amaliyotida pauza o‘quvchilarga juda yoqdi» kabi fikrlar uchradi.

Xulosa. Mikrofaollik pauzalari talabalar jismoniy faolligini qo‘shimcha vaqt va resurssiz, o‘quv jarayonining o‘zida rivojlantirish imkonini beradi. Texnologiyaning samaradorligi uch shartga bog‘liq: pauzaning mashg‘ulot bosqichlari chegarasiga joylashtirilishi, o‘qituvchi uchun tayyor vosita (kartochkalar banki) mavjudligi va pedagogika yo‘nalishi talabasi uchun kasbiy ma’no — pauzani o‘zi o‘tkazishni o‘rganishi. So‘nggi jihat texnologiyani jismoniy tarbiya sohasidagi innovatsiyadan bo‘lajak o‘qituvchining kasbiy tayyorgarligi elementiga aylantiradi va uni maktab amaliyotiga ko‘chirish istiqbolini ochadi [3].

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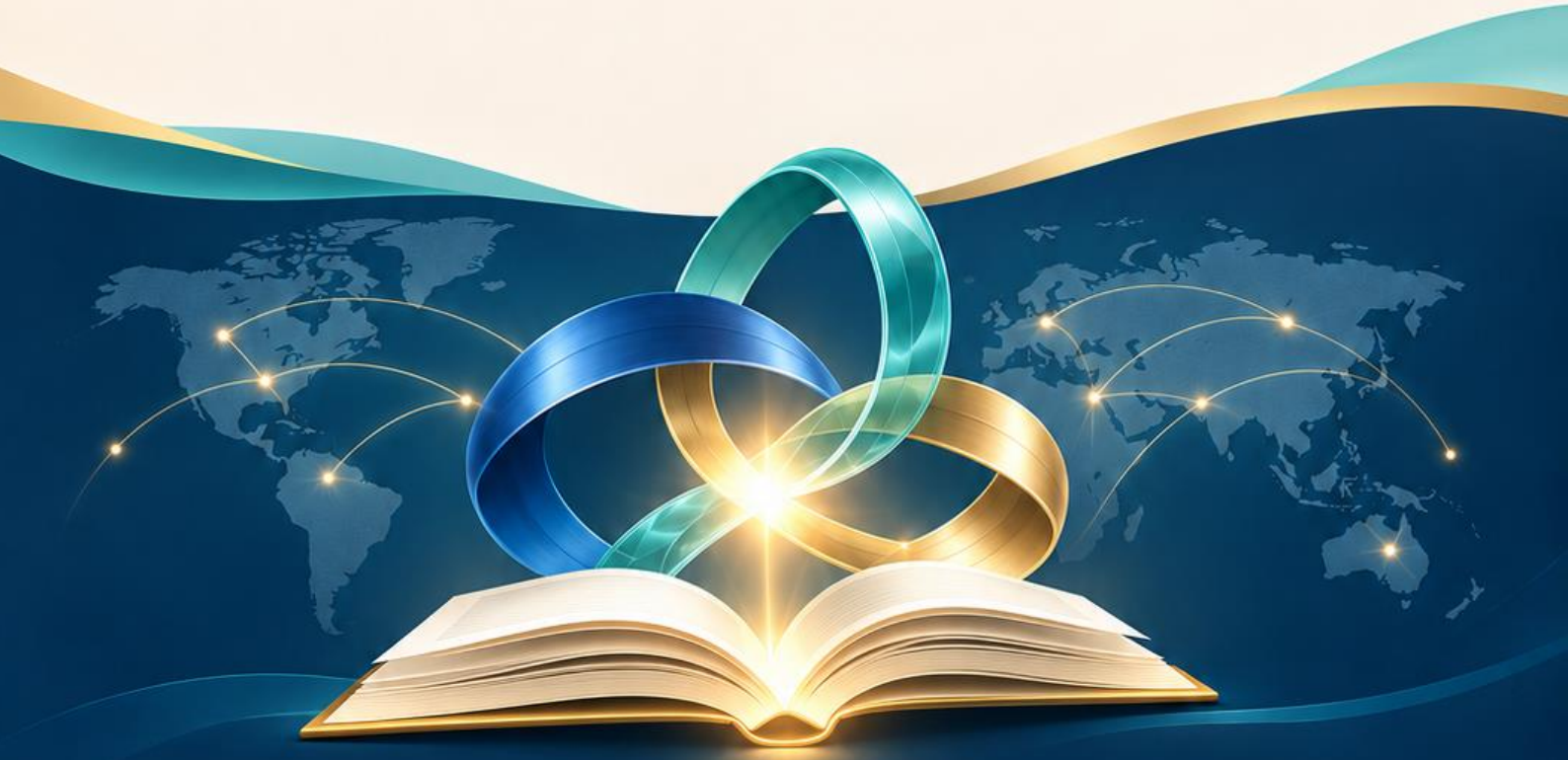

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