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ФИЗИКАЛЫҚ, ЭКОНОМИКАЛЫҚ ЖӘНЕ ӘЛЕУМЕТТІК ГЕОГРАФИЯ

Section 1

PHYSICAL, ECONOMIC AND SOCIAL GEOGRAPHY

Раздел 1

ФИЗИЧЕСКАЯ, ЭКОНОМИЧЕСКАЯ И СОЦИАЛЬНАЯ ГЕОГРАФИЯ

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ЕСТЕСТВЕННОЕ ЛЕСОВОЗОБНОВЛЕНИЕ ПОСЛЕ СЕЛЕВОГО ПОТОКА В АЛМАТИНСКОМ ЗАПОВЕДНИКЕ

Данная статья посвящена исследованию процесса естественного лесовозобновления после селевого потока. Селевые потоки представляют собой существенную угрозу лесным экосистемам, внося значительные изменения в структуру и состав лесных сообществ. Восстановительные процессы могут занимать разное время в зависимости от интенсивности селевого потока, локальных климатических условий и других факторов. Цель данного исследования состоит в изучении процессов естественного лесовосстановления, происходящих после селевого потока, воздействовавшего на территорию Алматинского заповедника. Основной задачей является анализ динамики растительного покрова, оценка влияния селевого потока на структуру лесного сообщества, идентификация видов, наиболее адаптированных к условиям естественного восстановления. Проведен анализ последствий селевого потока для лесных экосистем, выявлены особенности динамики формирования древесных пород фитоценоза и изменения его структуры, а также оценены факторы, влияющие на успешное восстановление лесного покрова. Результаты исследования позволяют более глубоко понять процессы естественного лесовозобновления и предоставить рекомендации для оптимизации природных механизмов восстановления лесов после природных катастроф, таких как селевые потоки. Полученные данные имеют практическое значение для управления лесными ресурсами и поддержания устойчивости лесных экосистем в условиях изменяющегося климата и природных бедствий.

Ключевые слова: Алматинский заповедник, древесные породы, селевой поток, естественное возобновление, берёза бородавчатая (Betula pendula), тополь Таласского (Populus talassica).

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Natural reforestation after a mudflow in the Almaty nature reserve

This article is devoted to the study of the process of natural reforestation after a mudflow. Mudflows pose a significant threat to forest ecosystems, causing significant changes in the structure and composition of forest communities. Recovery processes can take different times depending on the intensity of the mudflow, local climatic conditions and other factors. The purpose of this study is to study the processes of natural reforestation occurring after a mudflow that affected the territory of the Almaty Nature Reserve. The main task is to analyze the dynamics of vegetation cover, assess the impact of mudflows on the structure of the forest community, and identify species that are most adapted to the conditions of natural restoration. An analysis of the consequences of mudflows for forest ecosystems was carried out, features of the dynamics of the formation of tree species of the phytocenosis and changes in its structure were identified, and factors influencing the successful restoration of forest cover were assessed. The results of the study allow us to more deeply understand the processes of natural reforestation and provide recommendations for optimizing natural mechanisms of forest restoration after natural disasters, such as mudflows. The data obtained are of practical importance for managing forest resources and maintaining the sustainability of forest ecosystems in conditions of a changing climate and natural disasters.

Key words: Almaty Nature Reserve, tree species, mudflow, natural regeneration, warty birch (Betula pendula), Talassky poplar (Populus talassica).

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Алматы қорығында сел ағынынан кейінгі орманның табиғи жолмен қалпына келуі

Бұл мақала селден кейінгі табиғи ормандарды қалпына келтіру процесін зерттеуге арналған. Сел орман экожүйелеріне айтарлықтай қауіп төндіреді, орман қауымдастықтарының құрылымы мен құрамында елеулі өзгерістер туғызады. Қалпына келтіру процестері селдің қарқындылығына, жергілікті климаттық жағдайларға және басқа факторларға байланысты әртүрлі уақытты алуы мүмкін. Зерттеудің мақсаты – Алматы қорығы аумағына әсер еткен селден кейін болатын табиғи ормандарды қалпына келтіру процестерін зерттеу. Негізгі міндет – өсімдік жамылғысының динамикасын талдау, селдің орман қауымдастығының құрылымына әсерін бағалау, табиғи қалпына келтіру жағдайларына барынша бейімделген түрлерді анықтау. Орман экожүйелері үшін селдің зардаптарына талдау жүргізілді, фитоценоздың ағаш түрлерінің қалыптасу динамикасының ерекшеліктері және оның құрылымындағы өзгерістер анықталды, орман жамылғысының сәтті қалпына келуіне әсер ететін факторлар бағаланды. Зерттеу нәтижелері табиғи ормандарды қалпына келтіру процестерін тереңірек түсінуге және сел сияқты табиғи апаттардан кейін ормандарды қалпына келтірудің табиғи механизмдерін оңтайландыру бойынша ұсыныстар беруге мүмкіндік береді. Алынған мәліметтер климаттың өзгеруі және табиғи апаттар жағдайында орман ресурстарын басқару және орман экожүйелерінің тұрақтылығын сақтау үшін тәжірбиелік маңызы бар.

Түйін сөздер: Алматы қорығы, ағаш түрлері, сел ағыны, табиғи жаңарту, салпыншақ қайың (Betula pendula), Талас терегі (Populus talassica).

Введение

Исследования проводились на территории Алматинского заповедника, основанный в 1931 году. В настоящее время Алматинский государственный природный заповедник расположен в юго – западной части Талгарского района, Алматинской области в центральной части хребта Заилийский Алатау в пределах абсолютных высот от 1200 до 5000 м над уровнем моря. Заповедник занимает площадь 71700 га. Из них лесные угодья занимают 13211 га, в том числе: 12435 га, покрытые лесом угодья (в том числе лесные культуры старших возрастов 14 га), 771,9 га, не покрытые лесом угодья (в том числе гари 8,9 га, редины 763 га) 58489 га, занимают нелесные угодья, в том числе воды 123 га, дороги 10 га, усадьбы 2 га, ледники 20048 га, прочие угодья 38235 га. Территория заповедника разделена на два участка: Талгарский – площадью 40094 га, Есикский – площадью 31606 га. Вся территория относится заповедному режиму.

Важную роль в сохранении природных экосистем, включая уникальные и характерные горные ландшафты Северного Тянь – Шаня играет охрана и изучение природных комплексов Северного Тянь-Шаня. Территория заповедника охватывает несколько горных поясов:

– пояс кустарниково – разнотравных степей – до 1600 м н.у.м;

– пояс елово – лесной – от 1600 до 2500 – 2700 м н.у.м;

– субальпийский пояс – от 2700 до 3000 м н.у.м;

– альпийский пояс – от 3000 д о 3500 м н.у.м.;

– пояс гляциально – нивальный – выше 3500 м н.у.м. (Енкебаев Е и др., 2007:85).

Богат и разнообразен растительный мир заповедника. Его флора насчитывает 1440 видов, в том числе 960 видов высших растений, относящихся к 415 родам и 85 семейством. На территории заповедника произрастают 14 видов древесных пород, 64 – кустарников, 3 – кустарничков, 5 – полукустарников, 3 – лиан, 102 – однолетних, 52 – двухлетних и 722 видов многолетних растений. Наиболее разнообразно представлены семейство астровых – 136 вида, мятликовых – 92, розоцветных – 74, бобовых – 72 и крестоцветных – 51 видов. Низшие растения – более 480 видов. Из них водоросли и грибы – 377 видов, мхи и лишайники – 80 видов, папоротники – 15, голосеменных – 8. Редкими являются более 50 видов, 29 из которых занесены в Красную книгу Казахстана.

На территории заповедника обитает 41 видов млекопитающих, 177 видов птиц, 5 видов рептилий и 1 вид земноводных. Из них 4 вида млекопитающих (снежный барс, Тянь – Шанский бурый медведь, Туркестанская рысь, каменная куница), 12 вида птиц (беркут, бородач, шахин,

серпоклюв, кумай, филин, синяя птица, черный аист, сапсан, орел карлик, серый журавль, красавка), которые занесены в Красную книгу РК (Тогузаков Б., 2006:3).

Хребет Заилийского Алатау – месторасположение заповедника, находится на севере горной системы Тянь-Шань, в пределах абсолютных высот от 1200 до 5000 м над уровнем моря. Всего в заповеднике 160 ледников (с общей площадью 233,7 км²) в Заилийском Алатау. В своей центральной части он образует Талгарский горный узел, с самой высокой вершиной – пиком Талгар (4978,8 м). В заповеднике ещё более десятка вершин превышают рубеж 4500 м, среди них по основному хребту, пики – Актау – (4686 м), КОПР – (4612,6 м), Металлург – (4600 м), Богатырь – (4576 м) и Сулеймана Стальского – (4514 м над уровнем моря). На отрогах хребта наиболее высокие вершины – Близнецы – (4694 м), Иссыктенчоху – (4685 м), пик Белый – (4677 м), Жусанды – Кунгей (4565 м) и другие. От Чилико – Кебинского горного узла почти веерообразно отходят островершинные отроги, наибольшими из которых являются Безымянный, Северный, Талгарский и Жусанды – Кунгей. Эти отроги являются водоразделами крупных речных бассейнов: Левого, Правого и Среднего Талгаров, Жангырыка, Южного Талгара и Южного – Иссыка. В истоках всех рек находятся мощные ледники, например, Туристов, Дмитриева, Конституции, Тогузак, Калесника, Северцева, Богдановича, Шокальского (Благовещенский В.П., 2014:137). Все крупные реки и озёра получают основную подпитку от таяния ледников, которых в заповеднике большое количество. На южной стороне, в центре мощнейшего современного оледенения, находится ледник Корженевского длиной около 12 км и ледник Богатырь длиной более 8 км. На северной стороне хребта самый крупный ледник Шокальского, расположенный в бассейне реки Средний Талгар, имеет длину почти 5 км. В северной части территории наиболее крупные (от 16 до 28 км длиной) реки – Иссык, Левый Талгар, Правый Талгар и Средний Талгар. В южной части заметно выделяются Юго –Восточный Талгар (13 км), берущий начало с ледника Богатырь, и впадающий в него Южный Иссык (10 км), стекающий с ледника Корженевского. Обе реки очень полноводны, особенно в теплый период года. Юго – Восточный Талгар и Жангырык, сливаясь, дают начало реки Чилик – крупнейшей в Северном Тянь – Шане. Чилик 10 – 12 км протекает по границе заповедника. Питание рек осуществляется главным образом за счет сезонного таяния снегов, фирновых полей и ледников. Паводковый период начинается в апреле и длится всю весну и лето. Расход воды достигает в июле – августе 12 – 15 м/с и более. В отдельные жаркие дни, а также после ливневых дождей реки превращаются в ревущие бешеные потоки, энергия воды настолько велика, что монолитные скалы стачиваются, дробятся и перемалываются в песок, уступая путь её мощному натиску разрушающие берега и несущие крупные камни, гравий и песок. Зимой реки маловодны, не замерзают, но на изгибах и поворотах образуют мощные наледи, а в узких местах – арочные карнизы изо льда и снега между берегами. В заповеднике почти три десятка небольших (от 0,1 до 3,8 га) высокогорных моренных и ледниковых озёр. Все они лежат в руслах временных водотоков и питаются главным образом талыми водами. Эти озера, как правило, очень глубоки и накапливают значительные объёмы воды. В Заилийском Алатау гляциальные сели, образующиеся при прорывах моренных озёр, более опасны, чем дождевые сели. В летний сезон максимум активности гляциальных селей (95% их суммарного объёма) отмечается с 1 июля по 10 августа, когда в гляциальной зоне регистрируются максимальные температуры воздуха, интенсивная абляция ледников и активизация термокарстовых процессов на озёрных перемычках. Все сели объёмом более 100 тыс. м^3 сходили именно в этот период (Медеу А.Р., 2020:222).

Заилийский Алатау является одним из самых селеопасных горных районов Казахстана. Объемы селей могут достигать нескольких миллионов м3. В то же время этот район отличается высоким социально-экономическим развитием. На селевых конусах выноса северного склона Заилийского Алатау расположена крупная городская агломерация с центром в городе Алматы с населением более 2,5 млн человек. Селевые потоки представляют большую угрозу для населения и экономики района. Селевые катастрофы с многочисленными жертвами и большим материальным ущербом происходили в 1921, 1963 и 1973 годах (Medeu et al., 2019). Поэтому задача защиты от селей является очень актуальной.

В верховьях реки Есик берущие своё начало в ледниках, расположены озера Акколь (площадью 16 га) на высоте 2140 м и Музколь (площадью 2 га) – 2400 м н.у.м. завально – тектонического происхождения (Григорьевич М., 1949:6).

Прекрасное озеро Есик, изначально именовавшееся Жасыл – Коль, существовало в первозданной красоте до 1963 года. В июле того года, мощный селевой поток, возникший в результате таяния ледников в верховьях реки Иссык, с силой природных стихий вырвался из ледниковой зоны. Огромные волны потока разрушили естественную плотину, опустошив озеро всего за четыре часа. В настоящее время озеро успешно восстановлено, однако его размеры уменьшились в два раза по сравнению с прежними (Байтұрбаев Н. и др., 2011:14).

17 июля 2014 года в верховьях реки Среднего Талгара произошло селевое бедствие. Начало селевого потока было зафиксировано в 11:30, но основной поток достиг своей максимальной силы в 14:00. Скорость селевого потока составила 75 кубических метров в секунду. Бурный поток, состоящий из воды, грязи и валунов, разрушил все в своем пути. Селевой поток размывал землю, унес служебный кордон № 4, уничтожил яблоневый сад на слиянии рек Правого и Левого Талгара, а также автомобильную дорогу в ущелье Правого Талгара. Интенсивный и разрушительный характер селевого потока полностью уничтожил деревья на своем пути. Процесс восстановления природной среды после бедствия требовал значительного времени и усилий. Этот случай подчеркивает мощь природных явлений и их способность оказывать значительное воздействие на окружающую среду.

Мониторинг селей в Казахстане недостаточно развит. Есть методы краткосрочного прогноза для Иле и Жетысу Алатау, а также рекомендации для Южно-Казахстанской области. ГУ «Казселезащита» и РГП «Казгидромет» используют методику Таланова, Киренской и Никифоровой для прогнозирования гляциальных селей, но она недостаточно точна для принятия эффективных решений. В ряде районов такие методы вообще отсутствуют, что требует активного развития новых прогнозных систем (Степанов Б.С., Яфязова Р.К., 2023:73).

Цель данного исследования состоит в изучении процессов естественного лесовосстановления, происходящих после селевого потока, воздействовавшего на территорию Алматинского заповедника. Основной задачей является анализ динамики растительного покрова, оценка влияния селевого потока на структуру лесного сообщества, идентификация видов, наиболее адаптированных к условиям естественного восстановления, а также определение факторов, способствующих или препятствующих успешному процессу регенерации леса в данной экологической зоне. Полученные результаты позволят разработать рекомендации по управлению и охране лесных экосистем в условиях возможного воздействия природных катастроф на их стабильность и биоразнообразие.

Материалы и методы

Научные исследования проводились визуально на территории Алматинского заповедника в ущелье реки Правого Талгара, Талгарского участка на высоте 1230 м над уровнем моря в течение девяти лет (2014 – 2023 гг.) после схода селевого потока. Бурный селевой поток размыл почву и полностью уничтожил деревья в своем пути. В ходе исследовании было зафиксировано естественное возобновление леса, представленного мягколиственными лесонасаждениями берёзы бородавчатой (Betula pendula) и тополя Таласского (Populus talassica). В первые три года (2014 – 2016 гг.) после селевого потока процесс восстановления природной среды требовал значительных временных и усилийных затрат. Этот процесс является важным механизмом, в рамках которого природная среда стремится восстановить свою структуру и функции после воздействия селевых потоков.

Исходя из шестилетних наблюдений (2018 – 2023 гг.) и в последующие годы, с периодическими измерениями раз в 2 – 3 года, были выявлены результаты. Объектом исследования стал третий год после схода селевого потока в 2018 году (Рисунок 1 и Рисунок 2), было отмечено естественное семенное возобновление (лесозаращивание) берёзы бородавчатой (Betula pendula) и тополя Таласского (Populus talassica). Этот процесс был стимулирован естественными природными явлениями, в результате которых семена этих древесных пород попали на открытый грунт под воздействием ветра (Зверев Д., 1970:51).

Проведенные научные исследования характеризуется тем, что заростание происходило медленно, с деревьями стремящимися вверх, чтобы получить больше солнечного света. Этот процесс является естественным механизмом для обеспечения разнообразия и устойчивости лесного сообщества. Был проведен сплошной учет естественного лесовозобновления каждой древесной породы с распределением результатов по возрасту и высоте. В ходе исследований было выявлено формирование мягколиственных лесонасаждений на площади 1 гектара. Были изуче-

ны сроки и продолжительность фенологических явлений: весеннего пробуждения, роста, цветения и плодоношения. Проведена оценка динамики роста зеленых веточек, а также измерено диаметр ствола деревьев на учетной площади с помощью измерительной ленты и мерной вилки.

Рисунок 1 – Селевой поток (2018г.)

Рисунок 2 – Мониторинг естественного лесовозобновления после селевого потока (2023г.)

В 2018 году молодые тополя и березы в Алматинском заповеднике были небольшими: тополя – 30 см в высоту и 0,4 см в диаметре, березы – 20 см в высоту и 0,5 см в диаметре. В 2019 и 2020 годах из – за жары они росли медленно. Однако, в 2021 и 2022 годах обильные дожди в мае – июле позволили деревьям быстро расти. У Березы приращение в высоту достигало на 1 – 1,5 метра и на 2 сантиметра в диаметре, в то время как у тополя на 1,40 – 2,2 метра в высоту и на 3 сантиметра в диаметре (Таблица 1,2). Кроны березы и тополя в средней и нижней частях конуса выноса сомкнулись в целом, что свидетельствует о некотором успехе в процессе естественного возобновления. Отмечено, что на учетной площади березы бородавчатой (Betula pendula) имеют больший прирост, и эта порода преобладает в составе подроста по сравнению с тополью Таласского (Populus talassica). Однако отмечается, что прирост деревьев разных пород по высоте варьировал в значительных пределах. Это обусловлено различиями в реакции на окружающие условия, включая количество осадков и другие факторы, влияющие на рост деревьев (Голоскоков П., 1949:6).

По проведенным научным исследованиям за шестилетний период, в 2023 году береза бородавчатая (Betula pendula) достигла высоты до 2 м, диаметр ствола 4 см, а тополь Талассский (Populus talassica) достиг высоты от 2,5 до 3 метров и диаметра ствола 5 см. (Таблица 3).

Берёза повислая, или берёза бородавчатая (лат. Bétula péndula) – вид растений рода Берёза (Betula) семейства Берёзовые (Betulaceae). Цветки зеленые, плоские неправильной формы, 1 см. Цветет с начала июня до конца июня. Чаще всего цветение длится 15 – 20 дней. Листья у растения сравнительно мелкие, длиной 4 – 7 см. Форма ромбически – яйцевидная, с заостряющимся кончиком и зубчатыми краями. После раскрытия листовая пластина имеет гладкую и липкую поверхность. Изнаночная сторона листвы матово – зеленая, а лицевая – глянцевая, темного зеленого оттенка. Как правило, листовые черешки недлинные в два или три раза короче, чем листовые пластины. Летом окраска листьев ярко – зеленая, осенью желтая, бронзовая. Береза повислая начинает плодоносить в возрасте десяти лет. Начало и конец цветения апрель – май месяцы одновременно с распусканием листьев (Мариковский И., Зверев Д., 1970:211).

Таблица 1 – Динамика роста березы бородавчатой

Насаждение	Площадь, га	Год	Высота (см, м)	Диаметр ствола в коре (см)
Береза бородавчатая	1	2018	20 см	0,5 см
		2019	60 см	0,7 см
		2020	80 см	0,9 см
		2021	1 м	1 см
		2022	1,5 м	2см
		2023	2,0 м	4 см

Тополь Таласского относится к семейству ивовых (сем.Salicaceae Lindl). Семейство ивовых включает около 400 видов, входящих в состав трех родов: тополь (Populus, 25 – 30 видов), ива (Salix, 350 – 370 видов) и чозения (Chosenia, 1 вид). Род, к которому принадлежит тополь, называется Populus. Этот род включает множество видов деревьев, среди которых в Алматинском заповеднике известны род. Populus – Тополь, Populus talassica Kom – Тополь таласский, Осина – Populus tremula L. Тополь – это древесное растение, характеризующееся рядом отличительных черт, таких как толщина ствола, высота, светлая окраска и форма кроны, которая может быть пирамидальной или округлой. Однако, эти особенности типичны для большинства представителей семейства тополевых. Тем не менее, каждый вид тополя имеет свои уникальные особенности. В Алматинском заповеднике кора тополя серая и гладкая, иногда с зеленоватым оттенком. Цветение обычно начинается в апреле, а плодоношение происходит в апреле – мае месяце. В молодом возрасте тополь растет очень быстро и предпочитает свет.

Он хорошо переносит зимние условия. Тополь обычно начинает формировать семена только после достижения возраста от 10 до 12 лет (Царёв П., 2019:121). Листья на коротких побегах округлые, длиной от 3 до 7 сантиметров и шириной от 3 до 6 сантиметров, с зубчатым краем. Они распускаются примерно через 20 дней после начала цветения. Осенняя раскраска листьев начинается в августе – сентябре, а опадение листьев заканчивается в октябре. Листья окрашиваются в оранжевые и золотисто – желтые тона, придавая дереву великолепный декоративный вид.

Анализ данных о высоте и диаметре ствола деревьев, представленных в таблицах и на рисунках, показывает успешное развитие и рост деревьев после схода селевого потока на учетной площади.

Таблица 2 – Динамика роста тополя Таласского

Насаждение	Площадь, га	Год	Высота (см, м)	Диаметр ствола в коре (см)
Тополь Таласского	1	2018	30 см	0,4 см
		2019	60 см	0,6 см
		2020	80 см	0,7 см
		2021	1,40 м	1 см
		2022	2,2 м	3 см
		2023	3,0 м	5 см

Таблица 3 – Среднее приращение за 6 лет (2018-2023)

Насаждение	Высота (см)	Среднее приращение высоты (см/год)	Среднее приращение диаметра (мм/год)
Береза бородавчатая	200	33,33	5,6
Тополь Таласского	300	50,00	7,6

Анализ таблицы показывает, что тополь Таласский (Populus talassica) демонстрирует более высокую скорость роста по сравнению с березой бородавчатой (Betula pendula). Тополь Таласский вырос на 50 см в высоту и 7,6 мм в диаметре в год, в то время как береза бородавчатая прибавила 33,33 см в высоту и 5,6 мм в диаметре за год.

Результаты и обсуждение

Полученные данные подчеркивают влияние климатических условий на процессы естественного лесовосстановления. Селевые потоки могут значительно изменять состав почвы, ее структуру и текстуру. После селевого потока почва может содержать больше или меньше питательных веществ, чем до него, что влияет на рост растений. Селевые потоки – это мощное естественное явление, которое может причинить значительные ущербы лесной экосистеме. Данное исследование направлено на оценку скорости и характеристик восстановления лесной экосистемы после селевого потока с использованием сравнительного анализа роста березы бородавчатой (Betula pendula) и тополя Таласского (Populus talassica).

В работе представлены результаты шестилетних исследований (2018–2023 гг.), проведенных после схода селевого потока. В ходе исследований было выявлено формирование мягколиственных лесонасаждений на площади 1 гектара. Были изучены сроки и продолжительность фенологических явлений: весеннего пробуждения, роста, цветения и плодоношения. Проведена оценка динамики роста зеленых веточек, а также измерено диаметр ствола деревьев на учетной площади с помощью измерительной ленты и мерной вилки. В 2018 году молодые тополя и березы в Алматинском заповеднике были небольшими: тополя – 30 см в высоту и 0,4 см в диаметре, березы – 20 см в

высоту и 0,5 см в диаметре. В 2019 и 2020 годах из-за жары они росли медленно. Однако, в 2021 и 2022 годах обильные дожди в мае-июле позволили деревьям быстро расти. У Березы приращение в высоту достигало на 1 – 1,5 метра и на 2 сантиметра в диаметре, в то время как у тополя на 1,40 – 2,2 метра в высоту и на 3 сантиметра в диаметре. К 2023 году было установлено, что береза бородавчатая достигла высоту 2 метра с диаметром 4 см, а тополь Таласский – от 2,5 до 3 метров с диаметром 5 см. Наблюдения показали, что соотношение лесовосстановления составило 70% для березы бородавчатой и 30% для тополя Таласского. Это свидетельствует о том, что береза более успешно восстанавливается после селевого потока и преобладает в растительности учетной площади. Данные наблюдений подтверждаются визуально: на учетной площади заметно больше берез, чем тополей.

В настоящее время высота мягколиственных лесонасаждений, таких как береза бородавчатая (Betula pendula) и тополь Таласский (Populus talassica), колеблется от 80 см до 5 метров. Это свидетельствует об успешном развитии и росте деревьев, что является положительным индикатором естественного лесовосстановления. Для более глубокого изучения вариабельности прироста и факторов, влияющих на успешное развитие мягколиственных лесонасаждений, потребуются дополнительные научные исследования. Эти наблюдения подчеркивают успех естественного лесовосстановления в течение периода научного исследования и важность поддержки подобных процессов для восстановления лесных экосистем.

Заключение

Научные исследования проводились визуально на территории Алматинского заповедника в ущелье реки Правого Талгара, Талгарского участка на высоте 1230 м над уровнем моря после схода селевого потока в течение девяти лет (2014 – 2023 гг.). В ходе исследовании было зафиксировано естественное возобновление леса, представленного мягколиственными лесонасаждениями берёзы бородавчатой (Betula pendula) и тополя Таласского (Populus talassica). В первые три года (2014 – 2016 гг.) после селевого потока процесс восстановления природной среды требовал значительных временных и усилийных затрат. Исходя из шестилетних наблюдений (2018 – 2023 гг.) и в последующие годы, с периодическими измерениями раз в 2 – 3 года, были выявлены результаты. Объектом исследования стал третий год после схода селевого потока в 2018 году, было отмечено естественное семенное возобновление (лесозаращивание) берёзы бородавчатой (Betula pendula) и тополя Таласского (Populus talassica). Этот процесс был стимулирован естественными природными явлениями, в результате которых семена этих древесных пород попали на открытый грунт под воздействием ветра. В результате проведенных научных исследований в течение шестилетнего периода (2018 – 2023 гг.), после схода селевого потока было зафиксировано естественное возобновление леса, представленного мягколиственными лесонасаждениями берёзы бородавчатой (Betula pendula) и тополя Таласского (Populus talassica). Этот процесс является важным механизмом, в рамках которого природная среда стремится восстановить свою структуру и функции после воздействия селевых потоков. Селевые потоки, вызванные проливными дождями, таянием снега или другими факторами, способны привести к серьезным разрушениям природной среды. Восстановительные процессы могут занимать разное время в зависимости от интенсивности селевого потока, локальных климатических условий и других факторов. Однако, несмотря на разнообразие вызывающих факторов, природные системы, как правило, обладают удивительной способностью к самовосстановлению. Таким образом, результаты нашего исследования подчеркивают важность и эффективность естественного процесса лесовосстановления, который имеет критическое значение для сохранения экологического равновесия и биоразнообразия в регионе.

В будущем планируется продолжить научные исследования в области формирования мягколиственных лесонасаждений и прироста деревьев различных пород на учетной площади Алматинского заповедника. Цель исследований – оценить текущее состояние естественного возобновления после селевого потока, а также изучить влияние различных факторов на экосистему данной учетной площади. Эти научные исследования будут направлены на углубленное изучение процессов естественного лесовосстановления и его динамики после природных катастроф.

Литература

Байтұрбаев Н., Жаныспаев Д., Сапарбаев К., Вишневская В. Алматы қорығына 80 жыл. – Алматы, 2011. – С.14 – 16.

Благовещенский В.П. Іле-Алатауының шыңдары мен мұздықтары. МОН РК. – Алматы: Институт географии, 2014. – С.137 – 238.

Голоскоков П. Флора и растительность высокогорных поясов Заилийского Алатау. – Алма Ата: Қайнар, 1949. – 6 – 14 с.

Григорьевич М. Гляциологические исследования в Казахстане. – Алма – Ата: НАУКА Казахской ССР, 1965. – С.5 – 17.

Енкебаев Е., Рысбай С., Тогузаков Ж. Алматинский государственный природный заповедник. – Алатау ажары. Алматы: Қағанат, 2007. – С.85 – 87.

Зверев Д. Труды Алма – Атинского государственного заповедника том IX. – Алматы:Қайнар, 1970. – С.51

Мариковский И, Зверев Д. Животный и растительный мир Алма – Атинского государственного природного заповедника. – Алма Ата: Қайнар, 1970. – 211 – 216с.

Medeu A.R., Blagoveshchenskiy V.P., Gulyayeva T.S., Ranova S.U. Debris Flow Activity in Trans-Ili Alatau in the 20th—Early 21st Centuries //Geography and Natural Resources. – 2019. – №. 3. – С. 292-298.

Медеу А.Р. Гляциальные сели в Заилийском Алатау за последние 120 лет. – Алматы, 2020. – С.222

Степанов Б.С., Яфязова Р.К. Сверхкраткосрочный прогноз дождевых селей и формирование селей в бассейнах рек Киши и Улкен Алматы 21 июля 2023 года //Гидрометеорология и экология. – 2023. – №4. – С. 73−83.

Тогузаков Б. Алматы мемлекеттік табиғи қорығының өсімдіктер және жануарлар әлемі. III – том. – Алматы: Қағанат, 2006. – С.3 – 7.

Царев А. П. Биолого-структурные особенности и палеопроисхождение рода Populus L.(обзор) //Лесной вестник/Forestry bulletin. – 2019. – Т. 23. – №. 2. – С. 121-126.

References

Baiturbayev N., Zhanyspayev D., Saparbayev K., Vishnevskaya V. (2011). Almaty қorygyna 80 zhyl [80 years of Almaty Reserve]. Almaty, 2011. – S.14 – 16.

Blagoveshensky V.P. (2014). Ile-Alatauynyn shyndary men muzdyktary [Peaks and glaciers of Ile-Alatau]. MSE RK. Almaty: Institute of Geography, 2014, 137 – 238.

Enkebaev E., Rysbai S., Toguzakov Zh. (2007). Almatinskij gosudarstvennyj prirodnyj zapovednik [Almaty State Nature Reserve]. Almaty: Kaganat, 2007, 85 – 87.

Goloskokov P. (1949). Flora i rastitel'nost' vysokogornyh pojasov Zailijskogo Alatau [Flora and vegetation of the high mountain belts of the Trans-Ili Alatau]. Alma Ata: Kaynar, 1949, 6 – 14.

Grigorievich M., Shabanov F. (1965). EGljaciologicheskie issledovanija v Kazahstane [Glaciological studies in Kazakhstan]. Alma – Ata: NAUKA Kazakh SSR, 1965, 5 – 17.

Marikovsky I., Zverev D. (1970). Zhivotnyj i rastitel'nyj mir Alma – Atinskogo gosudarstvennogo prirodnogo zapovednika [Flora and fauna of the Alma-Ata State Nature Reserve]. Alma Ata: Kaynar, 1970, 211 – 216.

Medeu A.R., Blagoveshchenskiy V.P., Gulyayeva T.S., Ranova S.U. (2019). Debris Flow Activity in Trans-Ili Alatau in the 20th—Early 21st Centuries. Geography and Natural Resources, 40(3), 292-298.

Medeu A.R. (2020). Gljacial'nye seli v Zailijskom Alatau za poslednie 120 let [Glacial mudflows in the Trans-Ili Alatau over the past 120 years]. Almaty, 2020, P. 222.

Stepanov B.S., Yafyazova R.K. (2023). Sverhkratkosrochnyj prognoz dozhdevyh selej i formirovanie selej v bassejnah rek Kishi i Ulken Almaty 21 iyulya 2023 goda [Ultra-short-term forecast of rainfall mudflows and mudflow formation in the Kishi and Ulken river basins Almaty 21 July 2023]. Hydrometeorology and ecology, 4, 73-83.

Toguzakov B. (2006). Almaty memlekettik tabigi қorygynyn osimdikter zhane zhanuarlar alemi. III – tom [Flora and fauna of the Almaty State Nature Reserveю. Volume III]. Almaty: Kaganat, 2006, 3 – 7.

Tsarev P. (2019). Biologo-strukturnye osobennosti i paleoproishozhdenie roda Populus L. [Biological and structural features and paleoorigin of the genus Populus L.]. Forestry bulletin, 23(2), 121-126.

Zverev D. (1970). Trudy Alma – Atinskogo gosudarstvennogo zapovednika tom IX [Proceedings of Alma – Athens State Reserve Volume IX]. Almaty:Kaynar, 1970, P.51

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ТЕОРЕТИЧЕСКИЕ И МЕТОДОЛОГИЧЕСКИЕ ПОДХОДЫ К ОПРЕДЕЛЕНИЮ ГЕОГРАФИЧЕСКОГО ФАКТОРА

Понятие «географические предпосылки» относится к факторам, которые образуются из положения региона на карте. Предпосылки могут охватывать климат, рельеф, почвенный покров, поверхностные воды, растительный и животный мир, а также расположение объекта относительно других регионов. Географические предпосылки оказывают влияние на все стороны жизни и деятельности людей в этом регионе, а также на развитие хозяйства страны в целом. Целью исследования статьи является рассмотрение теоретических и методологических подходов к определению понятия географический фактор и географические предпосылки, эволюцию взгляда на географический фактор в науке, изменение роли природной среды на протяжении становления науки. Данное исследование является важным, так как значение географических предпосылок будет возрастать с развитием глобальных прогнозов, связанных с анализом дефицита природных ресурсов и глобальных проблем. Методика исследования включает теоретический (дедукция), сравнительный и логический методы. В результате исследования составлена сравнительная таблица об изменении подхода к трактовке понятия географического фактора. В заключение исследования было определено, что с учетом развития общества изменялось отношение к природной среде как важному источнику существования государств. Исследование несет в себе практическую ценность для теоретической географии, так как географический фактор определяет возможность и ограничение для развития сельского хозяйства, промышленности, торговли, а также влиять на образ жизни, культуру и социальные отношения.

Ключевые слова: географические предпосылки, географическая среда, эволюция взгляда на географические факторы, географический детерминизм, географический нигилизм.

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Theoretical and methodological approaches to determining the geographical factor

The concept of «geographical preconditions» refers to factors that are formed from the geographical location of a particular region. Prerequisites may include climate, topography, soils, water resources, flora and fauna, and its geographic location relative to other regions. Geographical prerequisites influence various aspects of the life and activities of people in this region, as well as the development of the economy as a whole. The purpose of the article's research is to consider theoretical and methodological approaches to defining the concept of a geographical factor and geographical prerequisites, the evolution of the view of the geographical factor in science, the changing role natural environment during the development of science. This study is important, since the importance of geographical premises will increase with the development of global forecasts associated with the analysis of natural resource shortages and global problems. The research methodology includes theoretical (deduction), comparative and logical methods. As a result of the study, a comparative table was compiled on changes in the approach to the interpretation of the concept of geographical factor. At the conclusion of the study, it was determined that, taking into account the development of society, the attitude towards the natural environment as an important source of existence for states has changed. The study has practical value for theoretical geography, since the geographical factor determines the possibility and limitation for the development of agriculture, industry, trade, and also influences lifestyle, culture and social relations.

Key words: geographical prerequisites, geographical environment, evolution of the view of geographical factors, geographical determinism, geographical nihilism.

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Географиялық факторды анықтаудың теориялық әдістемелік тәсілдері

«Географиялық алғышарттар» ұғымы белгілі бір аймақтың географиялық орнынан қалыптасатын факторларды білдіреді. Алғы шарттарға климат, жер бедері, топырақ, су ресурстары, өсімдіктер мен жануарлар дүниесі, оның басқа аймақтарға қатысты географиялық орналасуы жатады. Географиялық алғышарттар осы аймақтағы адамдардың өмірі мен қызметінің әртүрлі аспектілеріне, сондай-ақ тұтастай алғанда экономиканың дамуына әсер етеді.

Мақаланың зерттеу мақсаты – географиялық фактор ұғымын анықтаудың теориялық және әдістемелік тәсілдерін алғышарттарын, ғылымдағы географиялық факторға көзқарастың эволюциясын, ғылымның даму барысындағы табиғи ортаның рөлінің өзгеруін қарастыру. Бұл зерттеу маңызды, өйткені географиялық үй-жайлардың маңыздылығы табиғи ресурстар тапшылығы мен жаһандық проблемаларды талдаумен байланысты жаһандық болжамдарды әзірлеу кезінде артады. Зерттеу әдістемесі теориялық (дедукция), салыстырмалы және логикалық әдістерді қамтиды. Зерттеу нәтижесінде географиялық фактор түсінігін түсіндірудегі көзқарастағы өзгерістер туралы салыстырмалы кесте құрастырылды. Зерттеудің қорытындысында қоғамның дамуын ескере отырып, мемлекеттердің өмір сүруінің маңызды көзі ретіндегі табиғи ортаға деген көзқарас өзгергені анықталды. Зерттеудің теориялық география үшін практикалық маңызы бар, өйткені географиялық фактор ауыл шаруашылығының, өнеркәсіптің, сауданың дамуының мүмкіндігі мен шектеуін анықтайды, сонымен қатар өмір салтына, мәдениетке және әлеуметтік қатынастарға әсер етеді.

Түйін сөздер: географиялық алғышарттар, географиялық орта, географиялық факторларға көзқарас эволюциясы, географиялық детерминизм, географиялық нигилизм.

Введение

Природные условия и природные ресурсы являются предпосылкой индивидуальной и коллективной деятельности общества (Matsa K.A. et al., 2014:90). В трудах исследователей и ученых понятие «географические предпосылки» и «географические факторы» часто рассматриваются в контексте влияния на различные аспекты общественной, экономической, культурной жизни, а также на способы мышления различных культур и наций (Nisbett R., 2004:25). Объектом нашего исследования является термин «географический фактор» и особенности изменения взглядов ученых на определение и значение данного термина. Во многих работах при изучении развития любого географического объекта активно изучается роль географических предпосылок в экономическом развитии (Sansyzbayeva A. et al., 2021:502). Географические факторы, такие как климат, доступность ресурсов, и природные барьеры, влияют на историческое развитие цивилизаций и формирование различий в уровне развития стран (Diamond J., 1999:98). Изменения в воззрениях на роль географического фактора в развитии общества имеют практическое и теоретическое значение. Понимание этой роли позволяет формировать современную идеологию отношений между обществом и природной средой и определять приоритеты в системе общество – природная среда. Развитие государств и цивилизаций привело к выделению различных географических предпосылок, которые влияют на экономику, политику, принятие важных дипломатических решений и социальные преобразования в стране (Rahman M., Nigar N., 2015:30). Роль географических факторов тем больше, чем большее место они занимают в составе общественной системы, особенно в составе производительных сил (Czuczor K. et al., 2023:801). Иными словами, роль географических факторов тем больше, чем древнее период. Например, с развитием сельского хозяйства и промышленного производства, значительное внимание уделялось доступности плодородных земель и природных ресурсов. В более современных и развитых обществах значительное значение приобретает доступ к современным технологиям и инновациям (Mustafayev Z. et al., 2024:21). Роль географического фактора менялась в разные исторические эпохи, особенно в отношении доминирующего природного ресурса (Hernández-Bedolla J. et al., 2017:2013).

Материалы и методы

Теоретико-методологическую основу исследования составили теоретические выводы

западных, российских и отечественных ученых. В статье использован метод сравнительно-географического анализа – путем создания таблицы были систематизированы взгляды ученых на определение географического фактора и предпосылок. С помощью теоретического и логического методов были собраны данные об изменении роли географического фактора в разрезе исторических эпох:

- в период доиндустриальной стадии образ жизни человека полностью зависел от природных условий, а его адаптация была ключевым фактором развития общества. В аграрно-ремесленном обществе происходит изменение взаимоотношений между человеком и природой, так как начинается осознанное и активное преобразование окружающей среды (например, ирригация, вырубка лесов, внесение удобрений);

- на этапе индустриальной стадии появляется убеждение, что человек стал хозяином природы, преодолевая ее ограничения и увеличивая свое воздействие на нее. Однако возникают противоречия между человеческой деятельностью и окружающей средой из-за хищнической эксплуатации ресурсов;

- на постиндустриальной стадии влияние человека на природу становится глобальным, негативные последствия достигают пика, что приводит к формированию экологического сознания и принятию мер для сохранения природы на международном уровне.

В результате анализа значения географического фактора в разные периоды составлена сравнительная таблица, показывающая эволюцию взглядов на объект исследования.

Результаты и обсуждение

Рассмотрев подходы к пониманию отношений между природой и обществом, авторами сформулирован вывод, что отношение к географическому (природному) фактору в развитии общества изменялось от эпохи к эпохе по мерее развития науки, общества, а также по мере изменения природных условий и сокращения природных ресурсов. Если в античный период и средние века мыслители рассуждали о роли природного фактора, а взгляды исследователей XVI-XVII веков направлены на рассмотрении климата в жизни общества, то в XIX веке от поиска человеческих основ природы перешли к исследованию исторических корней современных явлений природы. Подробнее анализ географического фактора был дан исследователями в период XVIII-XX веков. Среди различных факторов (экономическое развитие, демографическое развитие, формы собственности, развитие права, классовая борьба) важное место занял географический фактор (Таблица 1).

Таблица 1 – Географический фактор в научных географических школах

Период (школа)	**Взгляд на географический фактор**	**Видные представители**
Античность	Рассматривается влияние окружающей среды и в частности климата на физический тип народов, их обычаи и нравы, уровень развития общества и его политические формы, виды занятий, численность населения	Аристотель (384–322 гг. до н. э.), Полибий (200–120 гг. до н. э.), Посидоний (ок. 135 г. – ок. 51 г. до н. э.), Страбон (64/63 г. до н. э. – 23/24 г. н. э.), Гиппократ (460–370 гг. до н.э.), Витрувий (I в. до н. э.)
Средние века	Уделяется меньше внимания географической среде в связи с распространением теологии	Арабский историк и социолог Ибн Халдун (1332–1406) объяснял различия в жизни, быте, психическом складе, характере и обычаях народов и племен влиянием природных и климатических условий
XVI век	Возврат к рассмотрению природного фактора	Французский политик, философ, экономист Жан Боден (1529 (1530) – 1596) французский политик, философ и экономист, подчеркивал роль географического фактора в истории в своем труде “Шесть книг о государстве”.

Продолжение таблицы

Период (школа)	**Взгляд на географический фактор**	**Видные представители**
XVIII век	Философы эпохи Просвещения во Франции акцентировали внимание на влиянии климата и природы на жизнь человека в свете новых географических открытий	Ж. Ж. Руссо (1712–1778) развивал теорию естественного человека (дикаря); А. Р. Тюрго (1727–1781) в работе «Размышления о создании и распределении богатств» отмечал исторические формы социальной организации; Шарль Монтескьё (1689–1755) в сочинении «О духе законов» развивал теорию географического детерминизма; А. Барнав (1761–1793) политический деятель, адвокат, считал, считал, что географическая среда влияет на хозяйственную деятельность людей.
Историко-географическая школа Германии (XVII-XVIII века)	Географический детерминизм был широко распространен в тот период, исходя из этого все особенности общества объяснялись влиянием географии.	Карл Риттер в своей работе «Землеведение в отношении к природе и к истории людей, или всеобщая сравнительная география» связывал географический фактор и развитие истории человечества; Французский философ-эклектик Виктор Кузен (1792–1867) можно предсказать роль страны в истории по её географии (Кон И.С. 1979:59)
Середина XIX века	Отмечалось, что природа может сильно влиять на политическую и военную структуру общества, а географическое положение может как затруднять, так и поощрять различные аспекты жизни, такие как войны, торговля и другие виды контактов.	Генри Бокль (1821–1862) английский историк, географический фактор с устройством государства, религией и нравственными представлениями людей, развивал идеи географического детерминизма
Марксистская школа (XIX век)	Признавалось важное значение природной среды, однако считалось, что ее влияние заключается в том, что она может замедлить или ускорить развитие общества.	Г. В. Плеханов (1856–1918), в работе «К вопросу о развитии монистического взгляда на историю» (1895) отмечал в роли судьбы государства географический фактор; Л.И. Мечников (1838–1888) в своей работе «Цивилизация и великие исторические реки» старался объяснить ход развития человечества через взаимодействие природы и общества
Французская школа географии человека (конец XIX века – начало XX века)	Географическая среда рассматривалась как фактор, влияющий на различные виды деятельности человека, а общество рассматривалось как организм, адаптирующийся к изменяющимся географическим условиям. (географический поссибилизм)	Видаль де ла Блаш и его труд «Принципы географии человека» связывал социально-экономические стороны общества с географическим фактором.
Последняя треть XIX века – начало XX века	Утверждается мнение, что общество – организм, адаптирующийся к изменяющимся географическим факторам	Генри Спенсер (1820–1903), английский философ, утверждал, что географический фактор заставляет общество эволюционировать; Немецкий ученый и путешественник Фридрих Ратцель (1844–1904) развивал идеи географического детерминизма.
Современные исследования (XX – начало XXI века)	Развитие мысли в формате идеи – вызов природы и ответ общества	Арнольд Тойнби (1889–1975) в труде «Постижение истории» заложил основы идеи «вызов-ответ»; Карл Витфогель (1896–1988) и его труд «Восточный деспотизм» (1957) описывал влияние географических условий на развитие деспотизма в истории.

Взгляды российских географических школ систематизированы в таблице 2, где показано эволюция понятия географический фактор и географические предпосылки. Основатель географической школы в России Л.И. Мечников развивал теорию линейной эволюции общества (главным фактором выделялся географический фактор, фактор воды). С.М. Соловьев и В.О.Ключевский в своих трудах рассматривали пространственный фактор. Взгляды Г.В.Плеханова были основаны на теории географического детерминизма и преувеличении роли географической среды (Абдуразаков Р.А., 2011:38). Исаченко Иван Дмитриевич – советский и российский географ в направлении физической географии, большое внимание уделял физическим явлениям и процессам в природе. «Географический фактор» и его определение было ключевым понятием в его работах. Согласно Исаченко, географический фактор это любое естественное или общественное явление, определяющее развитие природы на определенных территориях. Исследователь уделял особое значение географическим факторам – природным, климатическим, почвенным, гидрологическим в жизни человека. Ключевой элемент, описывающий особенности территории, её специфические возможности использования – это главное утверждение о географическом факторе по Исаченко.

Лев Николаевич Гумилёв, известный советский и российский историк, этнолог, антрополог и писатель, развивал идею географического фактора как источника формирования и развития различных этносов и культур. Согласно мнению ученого, географический фактор представляет собой важный компонент миграции людей, влияющий на образование этноса, а также на их характер и судьбу. Он рассматривал влияние географических условий – климата, ландшафта, природных ресурсов на формирование и эволюцию народов и этносов в мире. Л.Н. Гумилёв утверждал, что географические факторы и история развития культуры этноса связаны, определяя и оказывая влияние на самобытность этноса.

Таблица 2 – Географический фактор в российских географических школах

Географическая школа	Взгляд на географический фактор	Видные представители
Географическая школа П.П. Семенова Тян-Шанского	Идеи антропоцентризма и связи закономерностей в природе	П.П. Семенов Тян-Шанский, Н.М.Пржевальский, В.И.Роборовский, Г.Н. Потанин, М.В.Певцов, В.А.Обручев, И.В. Мушкетов, Н.Н.Миклухо-Маклай
Университетская школа Анучина (1884 год)	Влияние географического фактора, включающего как природные, так и общественные элементы, на взаимодействие общественных и природных законов (Анучин В.А., 1982:19)	Д. Н. Анучин и его ученики Л. С. Берг и А.А. Борзов
Географическая школа Докучаева	Общество как часть материального мира природы, выделяя связи между ее компонентами и человеком.	В.В. Докучаев и несколько поколений его учеников, среди них В.И.Вернадский, А.Н. Краснов, Г.И.Танфильев, Б.Б. Полынов, А.Е.Ферсман, А.И. Войеков
Экономико-географическая школа Н. Н. Баранского	Баранский предостерегал от преувеличения роли природных условий (фатализм), а также от их недооценки (нигилизм). Отрицание значения природных условий и изоляция человеческого общества из его материальной среды приводят к идеализму, поэтому важно избегать как фатализма, так и нигилизма.	Н. Н. Баранский, Н. Н. Колосовский утверждали, что географический фатализм имеет негативное явление в случае преувеличения его роли, судьба страны во многом может и не зависеть от природных условий

В казахстанской науке географический фактор является ключевым элементом анализа, связанным с влиянием географических условий на общественные и природные процессы, формированием региональных особенностей и развития страны в целом. Географический фактор включает в себя такие аспекты, как климат, ландшафт, почвы, гидрология, природные ресурсы и распределение населения. Отечественные исследователи географический фактор анализируют в контексте его влияния на экономику, политику, культуру, а также на развитие экологически устойчивых территорий. Географическое положение Казахстана с его разнообразными природными комплексами, климатическими областями и природными ресурсами является центральным объектом изучения для определения влияния географического фактора на различные сферы жизни и деятельности человека. Отечественные ученые рассматривают географические факторы в виде системы, которая состоит из физико-географических и экономических групп. Тесное взаимовлияние групп факторов развития региональных социально-экономических территорий предполагает целостное и равновесное состояние экономических районов в соответствии с заданными направлениями развития (Саипов А.А., Михалев Р.К., 2016:240). Современные отечественные направления в географической науке развивают идеи о рациональном потреблении и эксплуатации окружающей среды и недр нашей страны, о невозможности пренебрежения соотношением между размерами территории и исчерпаемостью ресурсов (Meadows D., Randers J., 2014:88).

Заключение

Изучив разные подходы и определения географического фактора, с помощью сравнительно-теоретического метода нами составлена таблица, в которой раскрывается изменение значения географического фактора в обществе и мировой экономике. В статье выявлены периоды, когда происходила переоценка и недооценка значения географического фактора. Оценка роли природного фактора в разные периоды эволюционных изменений включает анализ природных процессов и явлений – геологических, экологических, климатических за период формирования нашей планеты. Основным выводом является тот факт, что исследования по этой теме имеют важное значение для понимания географических процессов изменения жизни на Земле и могут быть основой для прогнозирования предстоящих изменений в результате современных климатических и глобальных изменений. Значение исследования теоретических и методологических подходов к определению понятия географический фактор будут возрастать в будущем с развитием глобальных проблем. В вопросах исчерпаемости и истощения природных ресурсов данное исследование заслуживает особого внимания. Изучение значения географического фактора продолжаются и сегодня. Современными направлениями в изучении роли географических предпосылок являются динамика изменения климата, проявления стихийных явлений и их взаимосвязь в больших временных промежутках. В будущем значение исследований в области географических предпосылок и факторов природы будут возрастать с развитием глобальных прогнозов, связанных с анализом дефицита природных ресурсов и экологических проблем. Решением многих современных угроз природного характера является глубокий анализ влияния развития общества и природы (географического фактора), и их гармоничное развитие в перспективе.

Литература

Абдуразаков Р.А. Географический детерминизм и географическая школа в исторической науке в России на современном этапе //Вестник Дагестанского государственного университета. Серия 2: Гуманитарные науки. – 2011. – №2. – С. 78-88.

Анучин В.А. Географический фактор в развитии общества. – Москва: Мысль, 1982. – 433 с.

Кон И.С. История буржуазной социологии XIX – начала XX века. – М.: Наука, 1979. – 458 с.

Саипов А.А., Михалев Р.К. Система факторов социального и экономического развития страны в процессе обучения географии Казахстана по учебным программам с обновлённым содержанием //Сборник материалов III международной научно-практической конференции – инновации в образовании: поиски и решения. – 2016. – №3. – С. 240.

Czuczor K., Kozma G., Radics Z. The territorial tourism development strategies and implemented cross border cooperation projects in bihor county //GeoJournal of Tourism and Geosites. – 2023. – Т. 2. – №. 48(2spl). – С. 798–809. doi: 10.30892/gtg.482spl14-1080.

Diamond J. Guns, Germs and Steel: The Fates of Human Societies. -New York: W. W. Norton, 1999. 480 pp.

Hernández-Bedolla J., Solera A., Paredes-Arquiola J., Pedro-Monzonís M., Andreu J., Sánchez-Quispe S.T. The assessment of sustainability indexes and climate change impacts on integrated water resource management. //Water. – 2021. – Т. 23. – №. 9(3). – С. 213-222. doi: 10.3390/w9030213.

Matsa K.A., Logvin M.M., Lytovchenko I.V. Docent of the tourist and hotel business department. –Poltava University of Economics and Trade, 2014.

Meadows D., Randers J. Limits to growth The 30-Year Update Chelsea Green Publishing Company, White River Junction, Vermont. – Publisher Binom, 2014.

Mustafayev Z., Skorintseva I., Toletayev A., Aldazhanova G., Kuderin A. Comprehensive assessment of water supply of the Turkestan region for the development of economic sectors and recreational tourism //GeoJournal of Tourism and Geosites. – 2024. – Т. 52. – №. 1. – С. 20-29. doi: 10.30892/gtg.52102-1179.

Nisbett R. The Geography of Thought How Asians and Westerners Think Differently and Why//Brock Education Journal – 2004. – Т. 13. – №13(2). – С. 658-669.

Rahman M., Nigar N. GIS based Integrated approach to measure the spatial equity of community facilities of bangladesh. AIMS Geosci. – 2015. – Т. 43. – №. 8. – С. 67-84. doi: 10.3934/geosci.2015.1.21.

Sansyzbayeva A., Saipov A., Dunets A., Mussagaliyeva A., Ramazan, A. Geography of natural and recreational facilities in the development of economic integration of the border areas of Northern Kazakhstan and the Russian Federation //GeoJournal of Tourism and Geosites. – 2021. – Т. 35. – №. 2. – С. 499-506. doi: 10.30892/gtg.35230-677.

References

Abdurazakov R.A. (2011). Geograficheskij determinizm i geograficheskaya shkola v istoricheskoj nauke v Rossii na sovremennom e`tape [Geographical determinism and the geographical school in historical science in Russia at the present stage]. Herald of Dagestan State University Series 2. The Humanities, Vol. (2), 78-88.

Anuchin V.A. (1982). Geograficheskij faktor v razvitii obshhestva [The geographical factor in the development of society]. Moscow: MU`SL`, 433 p.

Czuczor K., Kozma G., Radics Z. (2023). The territorial tourism development strategies and implemented cross border cooperation projects in bihor county. GeoJournal of Tourism and Geosites, Vol.48(2spl), 798–809. https://doi.org/10.30892/gtg.482spl14-1080.

Diamond J. (1999). Guns, Germs, and Steel: The Fates of Human Societies. New York: W. W. Norton, 480p.

Hernández-Bedolla J., Solera A., Paredes-Arquiola J., Pedro-Monzonís M., Andreu J., Sánchez-Quispe S.T. (2021). The assessment of sustainability indexes and climate change impacts on integrated water resource management. Water, Vol. 9(3), 213-222. https://doi.org/10.3390/w9030213.

Kon I.S. (1979). Istoriya burzhuaznoj sociologii XIX – nachala XX veka. [History of bourgeois sociology of the 19th – early 20th centuries]. – Moscow: NAUKA, 977 p.

Matsa K.A., Logvin M.M., Lytovchenko I.V. (2014). Docent of the tourist and hotel business department. Poltava University of Economics and Trade.

Meadows D., Randers J. (2014). Limits to growth The 30-Year Update. Chelsea Green Publishing Company, White River Junction, Vermont. Publisher Binom.

Mustafayev Z., Skorintseva I., Toletayev A., Aldazhanova G., Kuderin A. (2024). Comprehensive assessment of water supply of the Turkestan region for the development of economic sectors and recreational tourism. GeoJournal of Tourism and Geosites, Vol. 52(1), 20-29. https://doi.org/10.30892/gtg.52102-1179.

Nisbett R. (2004). The Geography of Thought How Asians and Westerners Think Differently and Why. Brock Education Journal. Vol. 13(2), 658-669.

Rahman M., Nigar N.(2015). GIS based Integrated approach to measure the spatial equity of community facilities of bangladesh. AIMS Geosci, Vol. 8, 67-84. https://doi.org/10.3934/geosci.2015.1.21.

Saipov A.A., Mixalev R.K. (2016). Sistema faktorov social`nogo i e`konomicheskogo razvitiya strany` v processe obucheniya geografii Kazaxstana po uchebny`m programmam s obnovlyonny`m soderzhaniem. [The system of factors of social and economic development of the country in the process of teaching geography of Kazakhstan according to the curriculum with updated content]. Proceedings of the III International Scientific-Practical Conference “Innovations in Education Searches and Solutions, Vol.3, 221-240.

Sansyzbayeva A., Saipov A., Dunets A., Mussagaliyeva A., Ramazan A. (2021). Geography of natural and recreational facilities in the development of economic integration of the border areas of Northern Kazakhstan and the Russian Federation. GeoJournal of Tourism and Geosites, Vol. 35(2), 321-343. https://doi.org/10.30892/gtg.35230-677.

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A GEOGRAPHICAL EVALUATION OF THE AKTOBE OBLAST'S TOPONYM CHANGING AND ELIMINATION DYNAMICS FROM SOVIET NAMES

One significant component of cultural heritage is represented by regional toponymy. In post-Soviet nations like Kazakhstan, the decommunization – the process of dropping Soviet names – is a dynamic process now underway. Old names for geographical features and settlements are accepted and then given new ones as part of this process. The nation's historical and cultural legacy must be preserved, and this procedure is crucial to that goal. An examination of oikonyms in the Aktobe oblast demonstrates that decommunization brought about modifications linked to historical events in addition to affecting names connected to revolutionary and Soviet personalities. This is a continuous process that is built upon the creation of geographic databases. It is essential to remember that place name modifications are taken into account in relation to their frequency and sociolinguistic characteristics. A semantic categorization of place names in the Aktobe oblast was done using data analysis, and the changes in these names throughout the time under consideration were examined. The structure of renaming types in the post-Soviet era is analysed, and two major phases of transition are recognised. A considerable portion of toponyms were discovered to have had their names changed, which suggests that the cultural landscape of the area has changed. First and foremost, changes in the republic's geopolitical and socioeconomic landscape are to blame for the renaming. The post-Soviet era saw particularly notable developments, mostly related to the de-Sovietization process. Previous cultural strata underwent changes, which were reflected in the compression of old toponyms. The research examines the factors leading to recent alterations in the names of rural villages in the Aktobe oblast, as well as matters like the frequency of name recurrence. The research looks closely at how the Soviet names of the city of Aktobe were cleared of oikonyms and urbanonyms. Undertaken with student engagement, this field of study offers a comprehensive grasp of the dynamics and importance of the decommunization-desovetization process. The survey was completed by 76 students in the geography educational programme. A sociolinguistic study involving pupils was carried out to discern the current onomastic condition in the region.

Key words: toponymy, decommunization, desovietization, urbanonym, Aktobe oblast.

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Ақтөбе облысындағы ойконимдердің кеңестік кездегі атауларынан арылуы және қазіргі өзгеру динамикасын географиялық тұрғыдан бағалау

Аймақтық топонимика мәдени мұраның маңызды аспектісі. Посткеңестік елдерде, оның ішінде Қазақстанда декоммунизация деп аталатын кеңестік атаулардан арылу процесі белсенді түрде дамып келеді. Осы процестің аясында географиялық нысандар мен елді мекендердің ескі атаулары қайтарылып, жаңалары қабылданды. Бұл процестің еліміздің тарихи-мәдени мұрасын сақтау үшін маңызы зор. Ақтөбе өңіріндегі ойконимдерге жасалған талдау көрсеткендей, декоммунизация революциялық және кеңестік қайраткерлерге байланысты есімдерге әсер етіп қана қоймай, тарихи оқиғаларға байланысты өзгерістерге де әкелді. Бұл кеңістіктік деректер қорын әзірлеу негізінде жүзеге асырылатын үздіксіз процесс. Жер-су атауларының өзгерістері олардың жиілігі мен әлеуметтік лингвистикалық аспектілері аясында қарастырылатынын атап өткен жөн. Деректерді талдау негізінде Ақтөбе облысындағы жер-су атауларының семантикалық классификациясы жүргізіліп, олардың қарастырылып отырған кезеңдегі өзгерістері зерттелді.

формацияның екі маңызды толқыны анықталып, посткеңестік дәуірдегі атауларды өзгерту түрлерінің құрылымы талданды. Топонимдердің едәуір бөлігінің атауы өзгертілгені анықталды, бұл аймақтың мәдени кеңістігінің жаңарғандығын көрсетеді. Атаулардың жаңғыруы, ең алдымен, республика аумағындағы геосаяси және әлеуметтік-экономикалық өзгерістерге байланысты. Ерекше маңызды атаулардың жаңаруы посткеңестік кезеңде, негізінен десоветизация процесіне байланысты болды. Бұрынғы мәдени қабаттардағы өзгерістерді көрсететін ескі топонимдер сығымдалған. Зерттеуде соңғы жылдардағы Ақтөбе өңіріндегі географиялық атаулардың жаңару үдерістері, соның ішінде өңірлердегі ауылдық елді мекен атауларының өзгеруі, атаулардың қайталану жиілігі сияқты мәселелер талданған. Зерттеуде Ақтөбе қаласының ойконимдері мен урбанонимдерінің кеңестік атаулардан арылуы жан-жақты қарастырылған. Бұл бағыттағы зерттеулер студенттердің қатысуымен жүзеге асырылды және декоммунизация-десоветизация процесінің динамикасы мен маңызы туралы толық түсінік берілді. Сауалнамаға «География» білім беру бағдарламасының 76 студенті қатысты. Облыстың қазіргі ономастикалық жағдайы сараланып, студенттермен әлеуметтік лингвистикалық зерттеулер жүргізілді.

Түйін сөздер: топонимия, декоммунизация, десоветизация, урбаноним, Ақтөбе облысы.

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Географическая оценка динамики изменения и избавления ойконимов от советских названий в Актюбинской области

Региональная топонимика представляет собой важный аспект культурного наследия. Процесс избавления от советских названий, известный как декоммунизация, активно развивается в постсоветских странах, включая Казахстан. В рамках этого процесса возвращаются старые названия географических объектов и населенных пунктов, а также принимаются новые. Этот процесс важен для сохранения историко-культурного наследия страны. Анализ ойконимов в Актюбинской области, показывает, что декоммунизация не только затронула названия, связанные с революционными и советскими деятелями, но и привела к изменениям, связанным с историческими событиями. Это актуальный процесс, который проводится на основе разработки пространственных баз данных. Важно отметить, что изменения географических названий рассматриваются в контексте их частоты и социолингвистических аспектов. На основе анализа данных проведена семантическая классификация названий местностей Актюбинской области и изучено их изменение за рассматриваемый период. Выделены две важные волны трансформации, а также проанализирована структура видов переименований в постсоветскую эпоху. Было установлено, что значительная часть топонимов была подвергнута переименованию, что свидетельствует о изменении культурного пространства области. Трансформация названий обусловлена, прежде всего, геополитическими и социально-экономическими изменениями на территории республики. Особенно значимые изменения произошли в постсоветский период, преимущественно в связи с процессом десоветизации. Старые топонимы подверглись сжатию, отражая изменения в предшествующих культурных слоях. В исследовании анализируются процессы изменения географических названий в Актюбинской области за последние годы, в том числе изменения названий сельских поселений в районах, такие вопросы, как частота повторения названий. В исследовании всесторонне рассмотрено избавление ойконимов и урбанонимов города Актобе от их советских названий. Исследования в данной области проводятся с участием студентов и обеспечивают полное понимание динамики и значимости процесса декоммунизации-десоветизации. В опросе приняли участие 76 студентов образовательной программы «География». Дифференцирована современная ономастическая ситуация региона, проведены социолингвистические исследования со студентами.

Ключевые слова: топонимия, декоммунизация, десоветизация, урбаноним, Актюбинская область.

Introduction

The process of evaluating the processes of change and the removal of oikonyms from Soviet names in contemporary Kazakhstan is complex from a geographic perspective. Many places, geographical features, and administrative divisions have changed their names since the early 1990s, when the Soviet Union collapsed, to distance themselves from their communist past and take on more traditional, historically significant, or ethnically fitting names. In different parts of Kazakhstan, this process of oikonym change happened to varied degrees and with diverse dynamics. Name changes might happen swiftly and easily in certain places, but they can also need drawn-out debates and public surveys in other areas. The public's perception and the actions of local communities, which may favour or oppose changes, are important variables affecting the dynamics of change in oikonyms. The political environment and the power of local authorities are significant additional factors. Changes in oikonyms bring with them a number of difficulties and issues, including maintaining historical memory, honouring the cultural legacy of different ethnic groups, and coordinating new names with official records and mapping information. That being said, the process of purging Soviet names from oikonyms may generally be described as a slow, evolutionary shift meant to bring them into compliance with contemporary norms and reality. It is a reflection of a society's aspiration to reinforce its geographic and cultural identity while simultaneously seeking self-identification and reintegration into the global community.

The change of geographical names first of all results in updating maps. The composition of the population has much effect on the transformation of names. For example, the major part of the Aktobe oblast is populated by the Kazakh people so they demanded changing the names or returning the former names of settlements. Several symposiums and seminars were held regarding this issue, i.e. concerning the study of names of land and water bodies, settlements.

Many countries see a dynamic process of decommunization aimed at changing symbols and names related to the Soviet period of history. Scientists from post-Soviet countries present a broad overview of the transformations of oikonyms in their works (Teslenok S.A. et al., 2017:13; Gerasimenko T., Iskaliyev D., 2021:23; Gnatiuk O., Basik S., 2023:63; Ustavshchikova S., 2018:95). The change of oikonyms is a phenomenon that takes place not only in Kazakhstan but also in other post-Soviet countries. For example, it is clearly visible in Russia, Ukraine, Kyrgyzstan, Tajikistan and other countries how the names of streets, settlements and even geographical names have changed resulting in the formation of a new linguistic layer. In this respect T. Gerasimenko and N. Sviatosha specify in their studies that the change of names of settlements in Tajikistan began in 1992 (Gerasimenko S., Sviatokha N., 2020:320).

To a significant extent, these changes were associated with the construction of new national, political, and regional identities (Temirbayeva R.K. et al., 2022:43). Such construction occurred either "from above," meaning it was initiated and controlled by authorities of various levels through the "ideologization" of space, or with the participation of society and economic entities – in this case, typically outside of political and ideological purposes (Hubner E., Dirksmeier P., 2023:103).

We witness an opposing trend in the post-Soviet era that is defined by desovietization and derussification. All over the post-Soviet space, these changes are occurring at a rapid speed. Many post-Soviet researchers find it difficult to adjust to the process of eliminating names with "Soviet" and "Russian" connotations. However, this phenomenon is not unique to Kazakhstan but is also observed in other post-Soviet states.

The qualities of the called thing are reflected in each name, which determines how well it fits into different historical, geographical, and linguistic contexts. A significant amount of variety exists in the toponymic complex as a whole as well as in individual names, both across time and in place (Basik S., Rahautsou D., 2019:107; Rusu M., 2019:48; Gnatiuk O., Glybovets V., 2020:139).

During the Soviet period the names of land and water bodies, streets and settlements were given in a massive and unsystematic way and many of them were frequently repeated. That was the influence of the Soviet regime and the ideology of that time. The spelling of oikonyms in Russian also affected the meaning of the name of a settlement.

Regional and critical toponymy is still a little-studied area. The most critical issues presenting problems in the study of this field are the following: incomplete databases; no accurate differentiation of ethnolinguistic strata in regional toponymy; little number of historical and linguistic studies does not enable to restore the names of settlements at different stages (Rusu M., 2021:269; Chloupek B., 2018:23).

We shall be interested in the following elements of developments in post-Soviet Kazakhstan's toponymy in the current study:

- Sociocultural: as a method of identity construction; Sociological: as a component of all-encompassing social change;
- Politico-geographical: as a center-periphery diffusion phenomena, reflecting spatial-temporal disparities in components and regional practices of identity building;
- Political and managerial: as practices of identity management for political reasons.

The research aims to assess the contemporary dynamics of changes in toponyms in the Aktobe oblast from a geographical perspective.

For a long time, different layers of toponyms from various historical-geographical stages of development coexisted on the territory of the Aktobe oblast. Numerous factors influence the change of modern toponyms. Mass migration of representatives of other nationalities to their historical homeland has led to changes in toponymic layers. Russian toponyms appeared on the map of Kazakhstan in the late XIX century, with the majority emerging during Soviet times, after the formation of the Kazakh SSR. Russification and the ideological use of toponymy partially accompanied the renaming process.

The cultural-geographical situation in the Aktobe oblast, as well as throughout the entire post-Soviet space, has undergone significant changes at the turn of the XX-XXI centuries (Urazaeva K.B. et al., 2008:168). One of the essential aspects of focused modeling of onomastic space in modern Kazakhstan is national identification mainly through the names of geographical objects which is opposed to ideas having lost their value during the Soviet period. Street names, regional names, and many more things are only a few examples of the various ways in which the toponymic environment is evolving (Gridina T., Konovalova N., 2019:34).

Currently the process of updating the names of settlements and streets in the Aktobe region is in progress. Due to the growing size of the city its streets are given new names and streets with former Soviet names are renamed. Transformations in the geopolitical and political system, socio-cultural transformations are expressed in the change of street names. Streets and squares are important images of the urban environment. Renaming of the streets with Soviet-era names is a component of the overall process of urban planning and public infrastructure changes. The change of street names calls forth various reactions across the population and has an effect on sociocultural relations. To a great extend it is due to the multinational composition of the urban population and the cost of new street name signs.

Research materials and methods

The research into language development management in the Aktobe oblast yielded data characterizing the changes in street names in settlements and cities. Cartographic and geoinformation techniques were used to construct maps for historical geography and cultural heritage preservation purposes. The following materials were used as the source for the study: normative legal acts of the Republic of Kazakhstan from 1991 to the present, scientific literature, cartographic works, periodical press materials and alongside with that the documents of the Aktobe Oblast Department for the Development of languages and materials of the Institute of Geography on the "State Catalog of Geographical Names of the Republic of Kazakhstan", published in 2016 were analyzed (Abdrahmanova S.A. et al., 2016:530).

The cartographic method was widely applied in research work. That's due to the fact that this method, as some scientists consider, allows to gain insight into the main factors of historical and geographical processes in the region – the features of settling, past migration processes in the region, the culture of native peoples, interethnic ties, etc. (Chloupek B., 2018:23; Rose-Redwood R. et al., 2010:453).

The research work was carried out on the basis of drawing a comparison between maps of different periods, content analysis, geographical information, statistical and survey studies.

The population differs in its attitude on changing toponyms preserved from the Soviet period. A special survey aimed at solving this problem was conducted in November 2023. Students of the "Geography" Educational program took part in this survey.

The survey questions posed to the students were as follows:

1. Are you satisfied with the level of toponymic work in the Aktobe oblast?
2. Do you consider the toponyms given during the Soviet era important today?
3. In your opinion, what criteria are important when renaming and assigning new names to streets?
4. Are there many names of people in street or city names that you have never heard of?
5. What obstacles do you think exist when assigning names to streets for distinguished local figures in the Aktobe oblast?

6. Do you believe that principles of transparency and public participation will be upheld in naming and renaming settlements and objects?

7. Do you support the new names assigned to unnamed streets due to renaming or new assignments?

8. Do you think it is necessary to adhere to the principle of "Restoring historical names" when changing the names of settlements and streets?

9. How do you feel about the renaming efforts underway in the city?

10. What are your thoughts on the frequency of name repetition in the Aktobe oblast?

Results and discussion

Especially with regard to the numerous monument names honouring Civil War and revolutionaries, the ideological ideals of the Soviet period were realised. Lenin and his comrades, as well as Marx and Engels, are the names of the major thoroughfares in nearly every administrative territory of the former USSR. Basic ideological motifs, such as "shock labor," "virgin land cultivation," "fulfilling the five-year plan in four years," etc., served as the motivational basis for naming significant objects. This included linguistic policies, which frequently went against national customs. When the circumstances for this process developed, such as the dissolution of the Soviet Union, language democratisation, processes of actualizing national self-identity, etc., it became necessary to reject "everything Soviet" due to these biases in the actions of local authorities towards the adoption of Soviet ideological principles into the nominative system (Gnatiuk O., Melnychuk A., 2024:34). In the Aktobe oblast, the Russian toponymic layer formed in two stages. Several Russian names appeared before the revolution, while the majority emerged during the Soviet period. Toponymy became standardised and unified, and many facets of Kazakh society became Sovietized (and desovietized) and ideologicalized as a result of the rise of the national Soviet intelligentsia under the conventional system of government. Oikonyms changed primarily due to political changes. The year 1991, the collapse of the USSR, and the creation of independent states within the CIS marked a challenging period in Kazakhstan's history. From this moment, toponymic transformation began.

In the district, not only oikonyms but also street names, previously known as "Soviet" names, have been changed. For example, "Trud" (Labor), "Stroiteley" (Builders), "70th Anniversary of October," and so on. Street names were changed by the decision of the city authorities. They adopted the names of Kazakh figures, public figures, poets, and writers (Urazaeva K.B. et al., 2009:200).

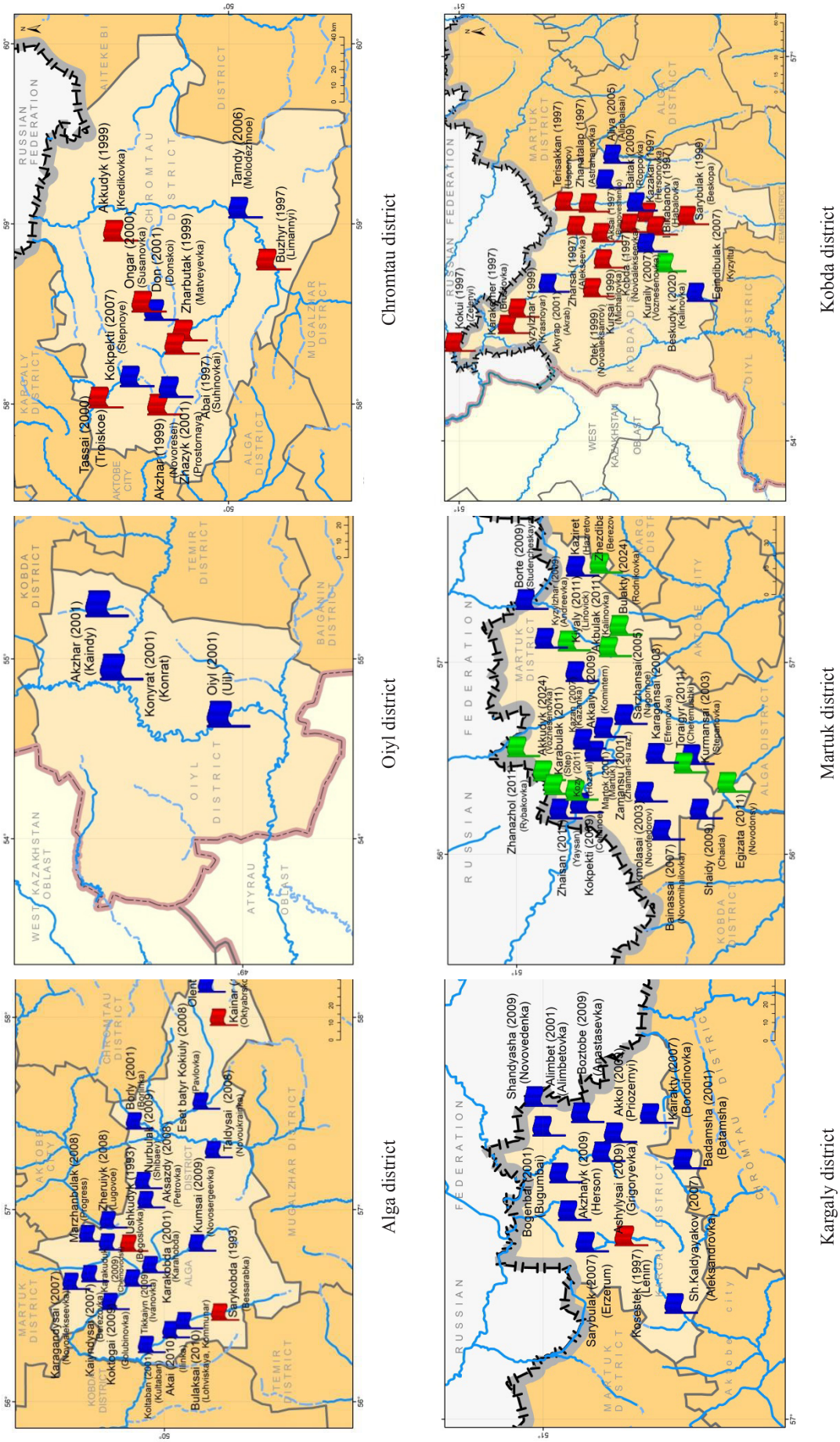
Since 1990, more than 150 oikonyms have been renamed in the Aktobe oblast (Figure 1). As shown in Fig. 1, the majority of changes or renaming of oikonyms in the Aktobe oblast occurred during the period from 2001 to 2010 (99 names). In the years 1990-2000, oikonyms in the Mugalzhar, Khromtau, and Kobda districts were changed. The renaming of names from 2011 to the present corresponds to settlements in the Martuk district. Additionally, in some districts, distorted names of settlements were corrected (Oyyl, Konyrat, Mamyr, etc.). As seen from the data, the change of oikonyms was mainly carried out in areas favorable for agriculture. This is confirmed by the transformation of toponyms in the Martuk, Kargaly, Alga, and Kobda districts.

The map was compiled and supplemented by the authors based on atlases of toponyms of the Aktobe oblast (Aktobe oblysy zher-su ataularynyn atlasy, 2012:40; Aktobe oblysy zher-su ataularynyn atlasy, 2019:22).

The highest number of name changes in the last twenty years occurred in 2012, with approximately 340 oikonyms changing their previous names. Figure 2 shows the proportion of renamed settlements by district.

As of right now, the Republic has instituted a State Onomastic Commission to streamline the process of renaming topographic objects (mostly ergonomic) in accordance with the new notion of state language policy. The names that are part of Kazakhstan's onomastic space should be highly associative semiotic signs that serve as both an address and an encapsulation of a potent national potential that is intimately associated with the country's history, economy, and culture (Polozhenie o Respublikanskoi onomasticheskoi komissii, 2022). To govern the process of naming state officials and people who have significantly influenced the republic's advancement in the domains of science, culture, literature, and the arts on geographic objects, guidelines have been devised in this respect.

There is now 87 streets and communities named after the poet Abai, just in the Aktobe oblast. This is a clear example of the extensive occurrence and "repetition" of memorial names for geographic features, according to official records from the regional onomastic commission. Furthermore, 29 localities and streets have the name Aliya Moldagulova in honour of the Soviet Union's Hero. Figure 3 shows the prevalence of name duplication in the Aktobe oblast.


Chromtau district
Oiyl district
Kobda district
Alga district
Martuk district
Kargaly district

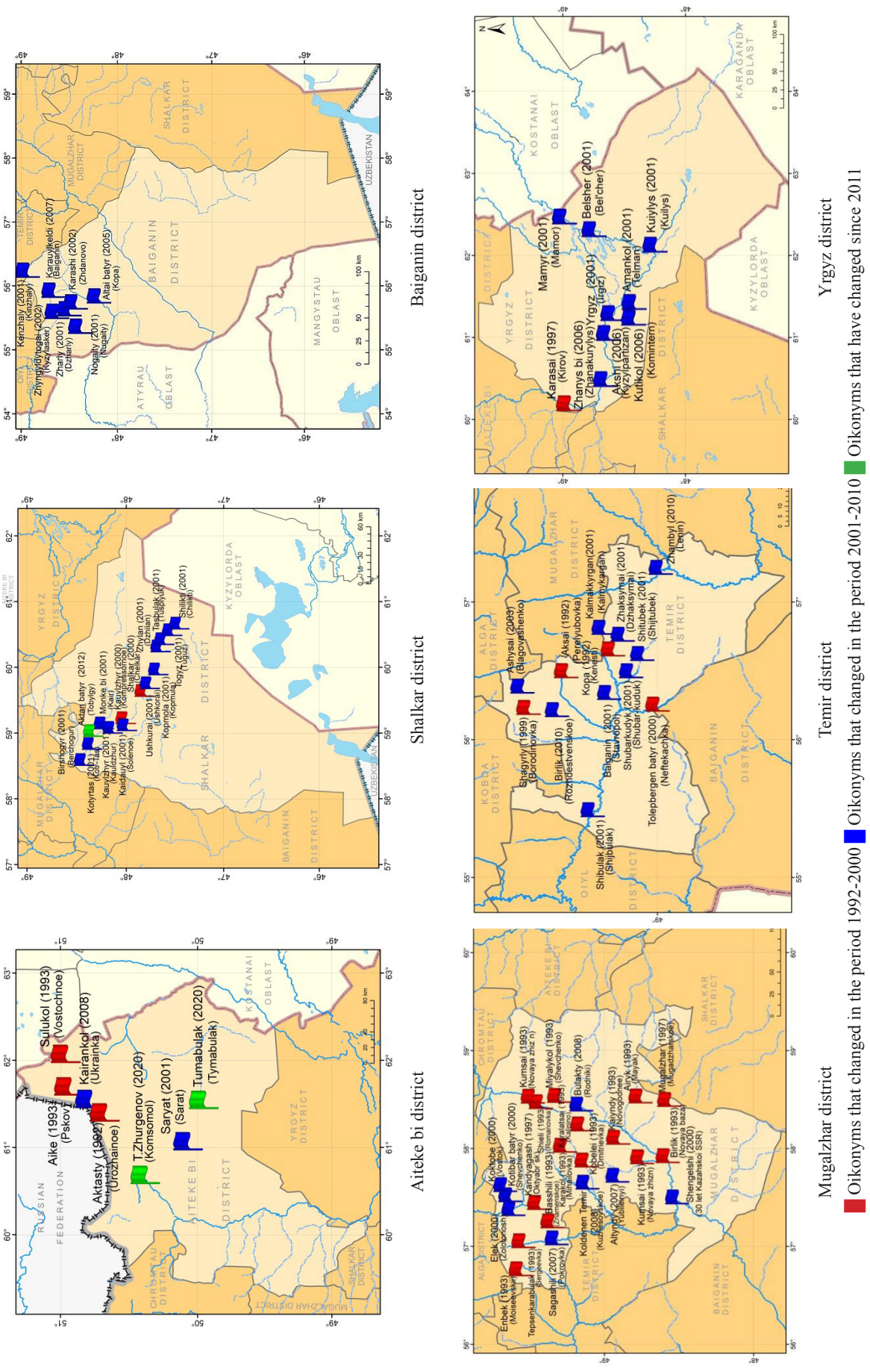


Figure 1 – Changes in Oikonyms by Districts of Aktobe oblast

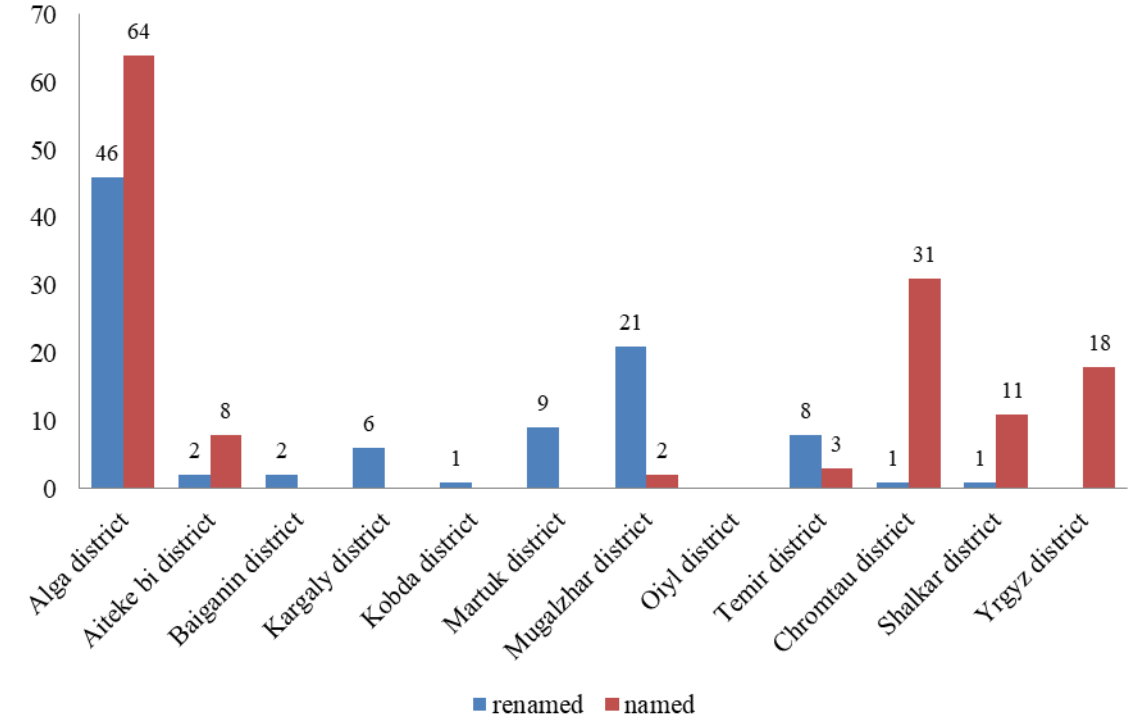


Figure 2 – Percentage of Renamed Settlements in Aktobe oblast by Districts

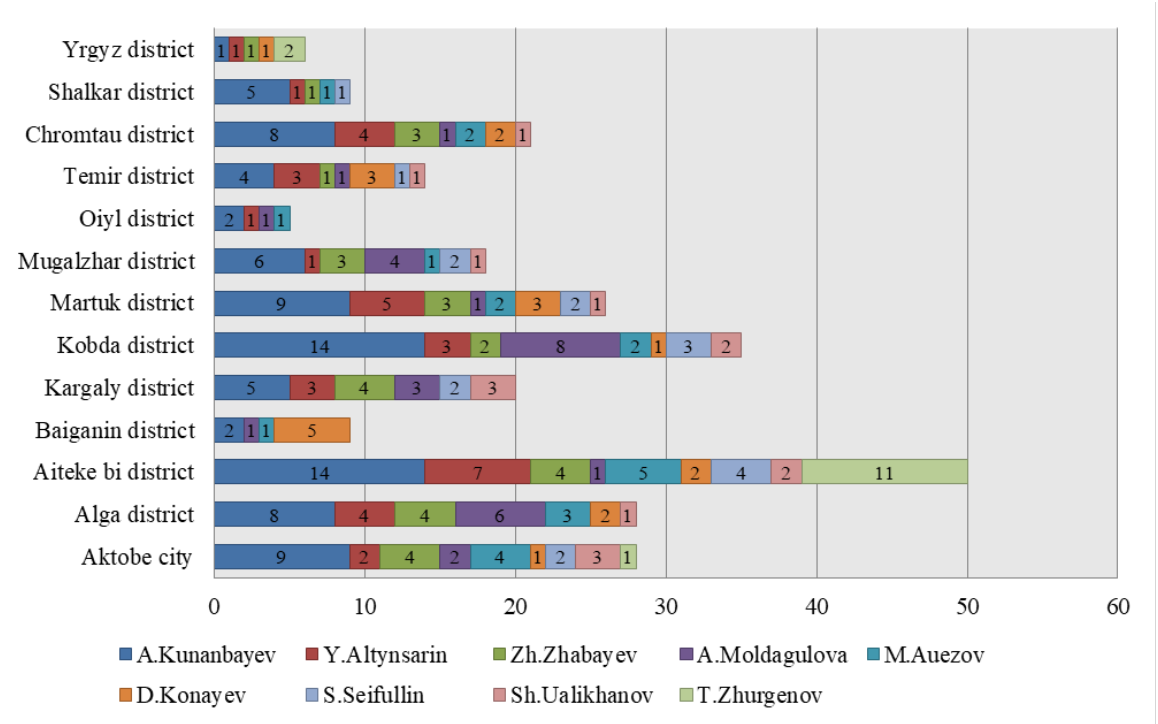


Figure 3 – Frequency of Name Repetition in Aktobe oblast

In March 2018, the administration of the city of Aktobe organized an international conference "Onomastics: Research and Experience," during which the main strategies for changing the names of urban objects in the region were defined during a briefing with representatives of the media: 1) Names that are ideologically out of date should be "aligned" with recent historical occurrences and national customs, implying a "name change."; 2) To restrict, if feasible, the naming of municipal landmarks after prominent figures from society and politics (for instance, several instances of local government petitioning the onomastic commission have been documented); 3) The Kazakh people's ethnic characteristics should be used to name settlements, streets, or specific urban objects (such as stadiums, parks, cultural palaces, schools, etc.) that do not already have names of well-known individuals who have made significant contributions to the development of national culture, art, or science; 4) Naming urban objects that have a strong connection to the national language, such as those with mythological motifs; 5) Excluding the use of multiple identical names and "numerological" designations for residential objects (Zarechnyj 1, Zarechnyj 2, Zarechnyj 3; Batys 1, Batys 2).

The onomastic condition in Kazakhstan is reflected directly in the created tactics. Following the lifting of the recent ban on name changes, 224 streets in Aktobe have been renamed, and over 100 additional streets, municipalities, and villages are scheduled to be renamed. A plethora of items in need of names has emerged as a result of the ongoing creation of new local districts. It has been discovered that there are 157 nameless streets in the expanding city of Aktobe (Figure 4).

With numerous geographical landmarks bearing names that have remained unchanged since the time of Tsarist Russia, such Demidovka, Voznesenovka, Velikhovka, and Petropavlovka, the topic of changing them is frequently debated in Kazakhstani media. The need of "giving true national names" to the Kazakh people is also emphasised at the same time (Shaukulova A., 2018).

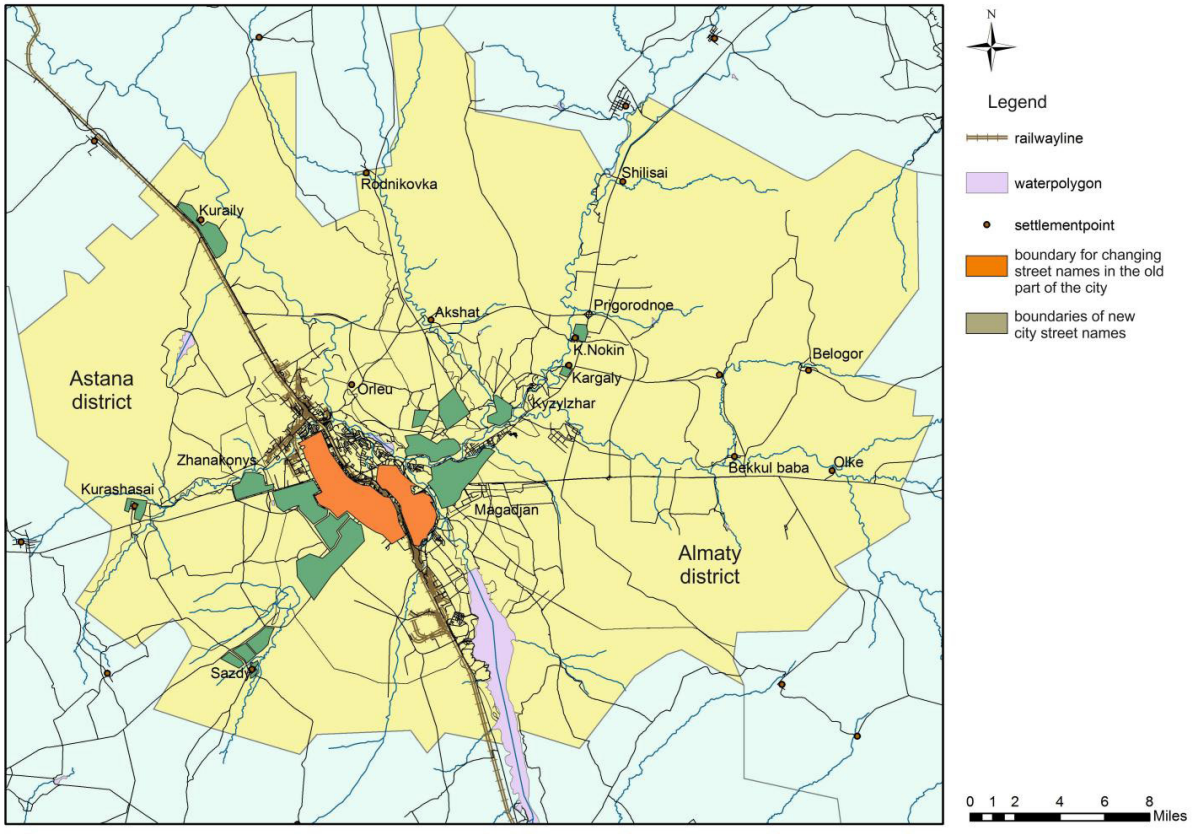


Figure 4 – Boundaries of Street Name Changes in the City of Aktobe and its Suburbs

It is possible to identify both objective and subjective justifications for renaming urban objects by taking into consideration the developed methodologies. The naming of many unnamed streets and the alteration of numerical ergonyms (for example, 11 mkr, 12 mkr, Ақzhar-1, Ақzhar-2, Batys 1, Batys 2, etc.) are objectively justified. The most obvious justification is the desire to uphold national goals by giving a famous person's name a memorial title. As a result, a number of streets and other urban features in the city of Aktobe now have the names of notable public and political personalities from Kazakhstan, as well as poets, authors, cultural icons, and heroes from the country's epic tales. Much of this collection of names "rejects" the range of naming practices that arose throughout the establishment and historical evolution of ergonomic systems in this area. We may use a variety of groupings of organisations whose names have been altered or are presently being considered for change to represent this. The names of streets that serve as orientation markers show where the street is located within the city, taking into account any surrounding objects: Yugo-Zapadnaya, 1 (now S. Mukanova Street); Centre (Ortalyk) – (now M. Bukenbaeva); Depovskaya (S. Zhamankulova), Zarechnaya (G. Zhubanova), Sovkhozny Proezd – Ush Tagan, Garnizonnaya – Zh. Dosmuhameduly; together with Vokzalnaya, Stantsionnaya, Privokzalnaya, Pochtovaya, Stadionny dead-end pools, Residential pool Zarechny, and more were modified.

The following are the names of ideological figures associated with Soviet reality and symbols: Party Alley XX Congress – K. Ospanov; October 50th anniversary –T. Akhtanov; Oktyabrya 70th anniversary—Jeruyik; Oktyabrskaya—D. Berkimbayev; Oktyabrsky boulevard – Abaya prospect; Kommunisticheskaya – Yu. Altynsarin; Kolkhoznaya – Altai batyr; Sovetskaya – M. Otemisova; Komsomolskaya – Karasai batyr; Pravda – Karagul batyr; Prospekt Truda – Sankibai batyr; Druzhba – E. Taibekov, and others. Some of the names, including Profsoyuzny tupik, Novokooperativnaya Street, Industrialnaya Street, etc., are continually changing. The following street names have been replaced in honour of communist (revolutionary) movement leaders and ideologists: K. Marx, F. Engels, V. Lenin, and others; also honoured are heroes of the American Civil War: Engels – Brothers Zhubanov, Kirov – Eset batyr, Frunze – Zhankozha batyr, Frunze tuyiki – Izgilik, K. Liebknecht – Scherniaz, Schmidt – Moncke bi, R. Luxembourg – D. Nurpeisova, Kuibyshev – Samruk, Kotovsky – Gabit Musiperov, Vorovskogo – Zangar, and others. The names of the occupations of the workers were used to rename streets: Fabrichnaya (street S. Kurmanalina), Svyazistov (street M. Prozorova), and Stroitelnaya (street Ryskulova).

There has been minimal modification in the names of streets and ergonyms that honour Patriotic War heroes and events. In the city of Aktobe, names like Z. Kosmodemyanskaya, N. Gastello, the 101st Rifle Brigade, Victory Avenue, A. Maresyev, O. Koshevoy, and other names of Soviet Union heroes have been preserved (Sultangalieva G., Kubenova G., 2006:120). Nonetheless, there are a few rare instances of ergonym names changing within this category; these primarily pertain to S. Tyulenin Street, which was renamed in honour of M. Ospanov, the first Chairman of the Majilis of the Parliament of the Republic of Kazakhstan, and Voroshilov Street, which became T. Zhurgenov Street.

The names of streets reflecting geographical features have been changed as well. For instance, Steppnaya Street was renamed to A. Smagulov Street, and Belogorskaya Street was renamed to Aktau Street. There are no street renamings honouring great figures in science, literature, art, or international culture. Avenues such as Tchaikovsky, Turgenev, Pushkin, Lomonosov, Nekrasov, Shevchenko, Mendeleev, and so on are still unaltered. Streets named for poets and authors from the Soviet Union have occasionally had their names changed. For instance, M. Gorky Street was renamed to Asau Barak, and D. Bedny Street was renamed to Kasym Khan. Streets named after external characteristics have also changed. For example, Fan Street was renamed to I. Biltabanov Street, Minor Alley was renamed to Fairground Street, and Dull Alley was renamed to Kokzhiyek Street. Currently, the list of changing ergonyms in this group includes Snezhnaya, Kovyl'nyj, Letnyaya, and Zvezdnaya Street.

Table 1 presents the findings of the student survey.

As part of the organically evolving toponymic system, the names are being replaced from the established motivating paradigm of Kazakh toponyms. Finally, it should be highlighted that the primary trend of intentional modelling of the onomastic continuum in the contemporary region is the expression of national identity against the background of concepts that have become obsolete in the context of the Soviet Union.

Table 1 – View of young people to the level of onomastic works of the Aktobe oblast

№	Survey questions	The answer is surveying		
1	The level of onomastic works in the Aktobe oblast	High 51	Average 25	Low 0
2	The modern meaning of the name, given in the Soviet era	High 0	Average 9	Low 67
3	Important criteria when changing and assigning new names of streets	Durability 0	Achieve justice without succumbing to corruption 0	Both criteria are important 76
4	Are there names of people you have never heard of in the names of streets or settlements	Right 20	I will refrain 14	Against 42
5	What obstacles do you think exist when assigning names to streets for distinguished local figures in the Aktobe oblast	Requires many documents 15	There are not enough state awards for a local figure 11	Both criteria are important 50
6	Do you believe that principles of transparency and public participation will be upheld in naming and renaming settlements and objects	High 0	Average 9	Low 67
7	Do you support the new names assigned to unnamed streets due to renaming or new assignments	I support 71	I will refrain 5	I don't support 0
8	Do you think it is necessary to adhere to the principle of "Restoring historical names" when changing the names of settlements and streets	I support 69	I will refrain 7	I don't support 0
9	How do you feel about the renaming efforts underway in the city	I support 76	I will refrain 0	I don't support 0
10	Estimation of the frequency of repetition of the name in the Aktobe oblast	Many repetitions in oikonyms 65	Not many repetitions in oikonyms 11	I didn't notice any repetitions 0

According to the youth, the level of onomastic work in the region is high. The current significance of names from Soviet times is irrelevant for the youth. Some of them admitted that they didn't know the Soviet people at all. They believe that the most important criteria for changing and assigning new street names are the fame and obscurity of the person. This information has been analyzed in Table 1.

The process of changing and eliminating Soviet names of geographical objects, known as decommunization and desovietization, is of vital importance in modern society. Regarding the post-Soviet countries such as Kazakhstan, this process is critically significant and is of interest to researchers and society as a whole because of the following reasons:

1. Historical changes: during the Soviet period the Soviet names of geographical objects and settlements in post-Soviet countries were appointed by the "ruling" circles and the former names were replaced in accordance with the mandative ideol-

ogy. The modern change of names reflects historical changes and the striving of each nation to reassess its history and cultural heritage;

2. Symbolic meaning: Decommunization matters symbolically for society as changing the names of geographical objects expresses a change in personality and values. This process is of help for the countries to pass the transition period and consolidate their new identity;

3. Sociocultural changes: The change of oikonyms testifies to sociocultural changes in society including the development of the language, culture and values. It can also have an effect on the perception of different ethnic and socio-cultural groups and interaction between them;

4. Geopolitical context: The change of geographical names in post-Soviet countries is connected with the transformations in the geopolitical context, such as the striving for national identity, sovereignty and integration into the global community;

5. The study of the dynamics in oikonyms' changes speaks of a scientific interest to research the sociocultural transformation processes and the dynamics of geographical names in the context of the changing socio-political environment.

On the whole the geographical assessment of the dynamics of changing and using Soviet names of geographical objects represents the study allowing an understanding of the decommunization and desovietization processes and their impact on the sociocultural and geopolitical dynamics of post-Soviet countries.

Conclusion

The study of the dynamics of changes in geographical names in the Aktobe oblast is of importance to perceive decommunization and desovietization processes in the post-Soviet space. The oikonyms and urbanonyms of the oblast over the specified period which are under discussion reveal a significant number of changes that point at geopolitical, socio-economic and cultural transformations in Kazakhstan.

The analysis of changes in the names of land and water bodies, settlements of the Aktobe oblast opened the way to get insight into two important waves of transformation, the sources of which are associated both with geopolitical events and sociocultural changes in the republic. Special attention is focused on the process of sovietization and its impact on the structural and semantic features of toponyms. The study verified significant changes in the cultural space of the oblast and also pointed out that the changes of geographical names are connected not only with political changes but also with transformations in previous cultural strata.

An important part of the study was a survey conducted with the participation of students of the Geography program. This survey provided additional data on the perception and value of changes in geographical names and also exposed that students are not indifferent to the changes occurring in the society. Sociolinguistic studies were conducted which brought to light numerous aspects of the onomastic situation in the oblast.

On the whole this study represents an important contribution to understanding and studying the decommunization and desovietization processes in Kazakhstan in the context of changes in geographical names and also demonstrates the active participation of students in research work.

Naturally occurring nominative vectors, which are less prominent in the names of urban objects, still offer orienting and distinctive marking reasons that are customary for ergonomic systems that emerge on their own. We identify strategies of tracing and metaphor representing the national mindset of Kazakhstan from the perspective of the nominative procedures characteristic of natural nomination.

References

Abdrahmanov S.A., Gessko E.A., Kopaneva I.A. (2016). Kazakhstan Respublikasynyn geografiyalyk ataularynyn memlekettik katalogy [State catalog of geographic names of the Republic of Kazakhstan]. Vol. 13. Almaty. p.530.

Aktobe oblysy zher-su ataularynyn atlasy [Atlas of place-names of Aktobe region]. (2012). Department of Language Development of Aktobe region. Aktobe, p. 40.

Aktobe oblysy zher-su ataularynyn atlasy [Atlas of place-names of Aktobe region]. (2019). Department of Language Development of Aktobe region. Aktobe, p. 22.

Basik S., Rahautsou D. (2019). Toponymic politics and the symbolic landscapes of Minsk, Belarus. Geographia Cassoviensis, 13(2), 107-120. doi: 10.33542/GC2019-2-02

Chloupek B. R. (2018). A GIS approach to cultural and historical toponymic research in Nebraska. Journal of Cultural Geography, 35(1), 23-43. doi: 10.1080/08873631.2017.1317182

Gerasimenko T.I., Iskaliyev D. Zh. (2021). Transformation processes of the astyonyms on the geographical map of Kazakhstan (late XIX – early XXI centuries). Nauka. Innovation. Technology, 3, 23-42.

Gerasimenko T.I., Sviatokha N.U. (2020). Transformation of the oikonyms of the republic of Tajikistan: analysis and mapping. *InterCarto, InterGIS,* 26(4), 320-328. doi: 10.35595/2414-9179-2020-4-26-320-328

Gnatiuk O., Basik S. (2023). Performing geopolitics of toponymic solidarity: The case of Ukraine. Norsk Geografisk Tidsskrift-Norwegian Journal of Geography, 77:2, 63-77. doi: 10.1080/00291951.2023.2170827

Gnatiuk O., Glybovets V. (2020). Do street status and centrality matter for post-socialist memory policy? The experience of Ukrainian cities. Geographia Polonica, 93(2), 139-161. doi: 10.7163/GPol.0167

Gnatiuk O., Melnychuk A. (2024). Housing names to suit every taste: neoliberal place-making and toponymic commodification in Kyiv, Ukraine. Eurasian Geography and Economics, 65(1), 34-63. doi: 10.1080/15387216.2022.2112250

Gridina T.A., Konovalova N.I. (2019). Strategies of Renaming Urban Spaces and Places in the Post-Soviet States. Political Linguistics, 1 (73), 34-41.

Hubner E., Dirksmeier P. (2023). Geography of placemories: deciphering spatialised memories. Cultural geographies, 30(1), 103-121. doi: 10.1177/14744740221123564

Polozhenie o Respublikanskoj onomasticheskoj komissii [About the Republican Onomastic Commission]. Website of Ministry of Tourism and Sports of the Republic of Kazakhstan, 2022. URL. https://www.gov.kz/memleket/entities/tsm/documents/details/309102?lang=ru

Rose-Redwood R., Alderman D., Azaryahu M. (2010). Geographies of toponymic inscription: new directions in critical place-name studies. Progress in Human Geography, 34(4), 453-470. doi: 10.1177/0309132509351042

Rusu M. S. (2019). Shifting urban namescapes: Street name politics and toponymic change in a Romanian (ised) city. Journal of Historical Geography, 65, 48-58. doi: 10.1016/j.jhg.2019.07.001

Rusu M.S. (2021). Street naming practices: A systematic review of urban toponymic scholarship. Onoma Journal of the International Council of Onomastic Sciences, 56, 269–292. doi: 10.34158/ONOMA.56/2021/14

Shaukulova A. (2018). Vozvrashchenie k istokam [Return to the roots]. Aktyubinskij vestnik, 05.10.2018. URL. https://avestnik.kz/vozvrashhenie-k-istokam-3/

Sultangalieva G.S., Kubenova G.I. (2006). Ulicy goroda Aktobe: istoriya i sovremennost' [Streets of Aktobe: history and modernity]. Aktobe: AGPI. p. 120

Temirbayeva R.K., Yegemberdiyeva K.B., Orazbekova K.S., Kozhirova S.B., Alkeev M.A. (2022). Turkic toponyms in the Kazakh-Russian borderlands: inventory and systematization. Journal of Geography and environmental Management, Vol. 67 No. 4, 43-52. doi: 10.26577/JGEM.2022.v67.i4.04

Teslenok S. A., Ivlieva N. G., Uchevatkina N. V., Teslenok K. S. (2021). Creation of a specilized toponymic GIS for areas of derussification, desovietization and decommunization. *InterCarto, InterGIS*, 23(2), 13-26. doi: 10.24057/2414-9179-2017-2-23-26-33

Urazaeva K.B., Utalieva Zh.T., Beknazarov R.A. (2008). Toponimiya Aktyubinskoj oblasti: istoriko-etimologicheskie opisanie, klassifikaciya i strategiya pereimenovanij [Toponymy of Aktobe region: historical and etymological description, classification and strategy of renaming]. Aktobe, T.1, p.168.

Urazaeva K.B., Sultangalieva G.S. Utalieva ZH.T. (2009). Toponimiya Aktyubinskoj oblasti: istoriko-ehtimologicheskie opisanie, klassifikaciya i strategiya pereimenovanij [Toponymy of Aktobe region: historical and etymological description, classification and strategy of renaming]. – Aktobe, T.2, p. 200.

Ustavshchikova S. (2018). Problems of cities renameing in Central Asian countries. Contemporary Eurasian studies, 2, 95-106. https://www.elibrary.ru/download/elibrary_36829534_24114358.pdf

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2-бөлім

КАРТОГРАФИЯ ЖӘНЕ ГЕОИНФОРМАТИКА

Section 2

CARTOGRAPHY AND GEOINFORMATICS

Раздел 2

КАРТОГРАФИЯ И ГЕОИНФОРМАТИКА

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ИСПОЛЬЗОВАНИЕ ДАННЫХ КОСМИЧЕСКИХ СНИМКОВ ДЛЯ АКТУАЛИЗАЦИИ ВЕКТОРНОЙ КАРТОГРАФИЧЕСКОЙ ОСНОВЫ ТЕМАТИЧЕСКИХ КАРТ
(на примере горных районов Иле и Жетысу Алатау)

Топографические карты, используемые в качестве картографической основы тематических карт, создаются на основе данных определенного временного периода, а имеющаяся топооснова на исследуемую территорию издана в 1975-1990 годах, что не позволяет визуализировать последние изменения в состоянии местности. Одним из способов решения этой проблемы является использование актуальных источников данных. Задача успешно решается на основе визуального и автоматизированного использования данных ДЗЗ полученных из космических аппаратов среднего, высокого и сверхвысокого пространственного разрешения.

Цель этой статьи – провести сравнительный анализ данных дистанционного зондирования Земли на примере космических снимков Sentinel 2, Landsat-8, рассмотреть методики обработки космических снимков и использование данных дистанционного зондирования для актуализации векторных слоев картографической основы тематических карт.

В рамках выполнения задач с целью актуализации векторных слоев для обновления картографической основы исследуемой территории, в данной работе были использованы архивные и оперативные данные среднего разрешения, получаемые со спутников серии Landsat и Sentinel-2 и сервисы изображений Sentinel-2, а также цифровая модель рельефа (ЦМР) Airbus WorldDEM4Ortho.

Были использованы методы применения ГИС-технологий и ДЗЗ, классификации данных ДЗЗ и сравнительного анализа, визуального и автоматизированного дешифрирования. Для фильтрации коллекции изображений Sentinel-2 и определения облачности и облачной тени сформирован набор скриптов Python.

Использование данных ДЗЗ позволили охватить обширные и труднодоступные территории горных районов, значительно снизить затраты на сбор и обработку данных.

В результате была создана обновленная картографическая основа исследуемой территории. Картографическую основу можно применить при последующем анализе динамики и тенденций изменения природных и социально-экономических объектов.

Ключевые слова: ГИС-технологии, ДЗЗ, космические снимки, Sentinel 2, Landsat-8, дешифрирование, обработка космических снимков, картографическая основа.

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Using satellite images data for updating the vector cartographic basis of thematic maps (using the example of the mountain regions of Ile and Zhetysu Alatau) Selection and Landsat and Sentinel

Topographic maps used as the cartographic basis of thematic maps are created on the basis of data from the certain time period and the existing topographic base for the study area was published in 1975-1990, which does not allow visualizing recent changes of the area condition. One way to solve this problem is to use up-to-date data sources. The problem is successfully solved on the basis of visual and automated use of satellites remote sensing data of medium, high and ultra-high spatial resolution.

The purpose of this article is to conduct comparative analysis of the Earth remote sensing data using the example of Sentinel 2, Landsat-8 satellite images, to consider methods for processing satellite images and use of remote sensing data to update vector layers of the cartographic basis of thematic maps.

As part of the tasks of actualization of the vector layers for updating the cartographic basis of the study area, in this work was used archival and operational medium-resolution data obtained from Landsat and Sentinel-2 series satellites and Sentinel-2 image services, as well as Airbus WorldDEM4Ortho DEM.

The work used the methods of GIS technologies and remote sensing, classification of remote sensing data and comparative analysis, visual and automated interpretation. A set of Python scripts has been generated to filter the collection of Sentinel-2 images and to determine cloudiness and cloud shadow.

The use of remote sensing data made it possible to cover spacious and inaccessible areas of mountainous regions, significantly reducing the costs of data and processing.

As a result, the updated cartographic basis of the studied area was created. The cartographic basis can be used for subsequent analysis of the dynamics and trends in changes of natural and social-economic objects.

Key words: GIS technologies, remote sensing, satellite images, Sentinel 2, Landsat-8, decryption, decryption, processing of satellite images, cartographic basis.

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Тақырыптық карталардың векторлық картографиялық негізін жаңарту үшін ғарыштық түсірілім деректерін пайдалану (Іле және Жетісу Алатауы таулы аудандарының мысалында)

Тақырыптық карталардың картографиялық негізі ретінде пайдаланылатын топографиялық карталар белгілі бір уақыт кезеңіндегі деректер негізінде құрылады, ал зерттелетін аумаққа қолданатын топографиялық негіз 1975-1990 жылдары баспаға шыққандықтан, ол жер бедеріндегі соңғы өзгерістерді визуализациялауға мүмкіндік бермейді. Бұл мәселені шешудің бір жолы – ағымдағы деректер көздерін пайдалану. Міндет кеңістіктік дәлдігі орта, жоғары және өте жоғары ғарыштық ЖҚЗ деректерін визуалды және автоматтандырылған пайдалану негізінде шешіледі.

Бұл мақаланың мақсаты – Sentinel 2, Landsat-8 ғарыштық түсірілімдерінің мысалында Жерді қашықтықтан зондтау деректерін салыстырмалы талдау, ғарыштық түсірілімдерді өңдеу әдістерін қарастыру және тақырыптық карталардың картографиялық негізінің векторлық қабаттарын жаңартуға қашықтықтан зондтау деректерін пайдалану.

Зерттелетін аумақтың картографиялық негізін жаңарту үшін векторлық қабаттарды жаңарту мақсатында міндеттерді орындау шеңберінде бол жұмыста Landsat және Sentinel-2 сериясының спутниктерінен және Sentinel-2 сервистерінен, және де Airbus WORLDDEM4ORTHO жердің сандық моделінен алынған дәлдігі орташа ғарыштық түсірілімдердің мұрағаттық және жедел алынған деректері пайдаланылды.

ГАЖ технологиялары мен ЖҚЗ қолдану, ЖҚЗ деректерін жіктеу және салыстырмалы талдау, визуалды және автоматтандырылған дешифрлеу әдістері қолданылды. Sentinel-2 түсірілімдер жинағын өңдеу және бұлттылық пен бұлт көлеңкесін анықтау үшін, Python скриптер жиынтығы құрылды.

ЖҚЗ деректерін пайдалану мен кең аумақтарды және таулы аудандардың қиын жерлерін қамтуға, деректерді жинау мен өңдеу шығындарын айтарлықтай төмендетуге мүмкіндік берді.

Нәтижесінде зерттелетін аумақтың жаңартылған картографиялық негіз құрылды. Картографиялық негізді табиғи және әлеуметтік-экономикалық нысандардың өзгеру динамикасы мен тенденциясын талдау кезінде қолдануға болады.

Түйін сөздер: ГАЖ технологиясы, ЖҚЗ, ғарыштық түсірілімдер, Sentinel 2, Landsat-8, дешифрлеу, ғарыштық түсірімдерді өңдеу, картографиялық негіз.

Введение

Настоящая научная статья подготовлена в рамках выполнения проекта «Научно-прикладное обоснование селе-, оползне- и лавинобезопасности в горных районах Иле и Жетысу Алатау Республики Казахстан». Принципиальное отличие идеи программы от существующих аналогов в Казахстане заключается в создании детальных карт природных опасностей и рисков в цифровом виде с использованием методов дистанционного зондирования Земли. Для создания этих карт необходима крупномасштабная картографическая основа. В силу того, что существующие на данный момент топокарты содержат генерализированную и неактуальную информацию, в исследованиях использованы данные дистанционного зондирования Земли (далее – ДЗЗ), которые обеспечивают хорошую обзорность снимков и возможность получения информации о труднодоступных либо обширных территориях. По этой причине данные ДДЗ являются практически единственным источником объективной и актуальной информации при исследованиях в условиях пересечённой местности в горных районах. (Рамазанова, 2018:82; Cheng et al., 2016:28; Sreenivasan et al., 2018:603). Кроме того, несомненным достоинством данных ДЗЗ является актуальность на момент съемки, высокая оперативность их получения, точность обработки, информативность и экономическая целесообразность данных (Priyabrata et al., 2024:101093; Jeffrey et al., 2021:2191; Манилюк, 2017:11).

Данные ДЗЗ применены здесь при создании баз данных для ГИС проекта, в том числе и в качестве «базового» рабочего слоя, для актуализации векторных слоев картографической основы следующих тематических карт: водосборных бассейнов, гидрографической сети, ледников, моренных озёр, транспортной сети, населённых пунктов.

Полученные результаты значительно повысят уровень знаний о природных объектах и опасностях, а также будут использованы при планировании профилактических мер по предотвращению негативных последствий опасных процессов в горах Алматинской и Жетысуской областей. Потребителями полученных результатов будут органы предупреждения и ликвидации последствий чрезвычайных ситуаций МЧС РК, акиматы Алматинской и Жетысуской областей и районов, организации, занимающиеся планированием развития территорий.

Данные и методы исследования

Существует широкий набор оптических данных ДДЗ среднего, высокого и сверхвысокого пространственного разрешения, как WorldView-3, GeoEye-1, SPOT 6/7, Pleiades, Landsat-8, Sentinel и т.д. Однако, в открытом доступе нет снимков высокого и сверхвысокого пространственного разрешения. К бесплатным данным ДЗЗ относятся космоснимки с пространственным разрешением не выше 10 м, например, данные со спутниковых программ Sentinel и Landsat (Абиева Д.К., 2020:42; Комарова А.Ф., 2016:47; Landsat-8).

В последние годы для исследования часто используются архивные и оперативные данные среднего разрешения, получаемые со спутников серии Landsat и Sentinel-2. Свободный доступ к снимкам со спутников Landsat (Каналы Landsat 8; USGS EROS Archive) и Sentinel-2 (Data collections; Загрузка сцен Sentinel-2; Sentinel-2) делает их привлекательными для исследователей в разных отраслях. Данные космических съемок сегодня стали доступны широкому кругу пользователей и активно применяются не только в научных, но и производственных целях (Антонов С.А.,2018:100; Sinčić M., 2022:1360; Lim S., 2023; Толепбаева А.К., 2020:25).

В данной работе для актуализации векторных слоев картографической основы исследуемой территории были использованы архивные и оперативные данные среднего разрешения, получаемые со спутников серии Landsat и Sentinel-2, также ЦМР Airbus WorldDEM4Ortho (https://www.esri.com/arcgis-blog/products/arcgis-living-atlas/imagery/airbus-worlddem4ortho-in-arcgis-living-atlas-of-the-world).

Ниже приведена краткая сопоставительная сводка по основным параметрам и спектральным каналам спутников Landsat и Sentinel-2 для дешифрирования географических объектов (Таблица 1, Таблица 2).

Программа Landsat существует уже более 40 лет. В настоящий момент действуют два спутника серии: Landsat-8 (сенсоры OLI – Operational Land Imager и TIRS – Thermal Infrared Sensor), выведенный на орбиту в 2013 г., поддерживаемый совместно Геологической службой США (USGS) (таблица 1) и Национальным Аэрокосмическим Агентством (NASA) и Landsat-7 (ETM+). Все данные с этих спутников, начиная с 1982 г. совместимы между собой без дополнительной обработки (Каналы Landsat 8; USGS EROS Archive).

С 2016 г. на регулярной основе с периодичностью съемки в 10 дней стали доступны данные со спутника Sentinel-2A, выведенный на орбиту 23 июня 2015 г. в рамках программы Copernicus Европейским космическим агентством (ESA) (Data collections; Sentinel-2; Sentinel-2A, 2B).

Таблица 1 – Основные параметры Landsat-8 и Sentinel-2

Основные параметры	Landsat-8	Sentinel-2
Режим съемки	Мультиспектральный	Мультиспектральный
Пространственное разрешение, м	15 (PAN) 30, 100 (тепловой спектр)	10
Покрытие территории снимками	полное	частичное
Ширина полосы съемки, км	183	290
Периодичность съемки	16 дней	5 дней
Временной охват	с 1984 г.	с 2015 г.
Сайт загрузки	https://earthexplorer.usgs.gov	https://scihub.copernicus.eu

Второй спутник с аналогичными характеристиками Sentinel-2B был запущен 7 марта 2017 г., что позволило улучшить периодичность съемки до 5 дней.

Снимки Landsat OLI имеют 9 спектральных каналов, которые практически совпадают с каналами сенсоров Landsat-7 и Landsat-5. Sentinel-2A оснащен оптико-электронным мультиспектральным сенсором, который выполняет съёмку в 13 спектральных каналах от видимого и ближнего инфракрасного до коротковолнового инфракрасного диапазона спектра. При отсутствии панхроматического канала, пространственное разрешение изображений Sentinel-2 в видимом (R, G, B) и ближнем инфракрасном (NIR) диапазонах спектра составляет 10 м, что представляет наибольший прикладной интерес и является значимым преимуществом в сравнении с изображениями Landsat (Таблица 2).

Таблица 2 – Спектральные характеристики спутника Landsat-8 и Sentinel-2

Landsat-8 OLI			Sentinel-2		
Канал	Длины волн, мкм	Разрешение, м	Канал	Длины волн, мкм	Разрешение, м
Канал 1 – Побережья и аэрозоли (Coastal and Aerosol, New Deep Blue)	0,433 – 0,453	30 м	Канал 1 – побережья и аэрозоли (Coastal / Aerosol)	0,419 – 0,465	60
Канал 2 – Синий (Blue)	0,450 – 0,515	30 м	Канал 2 – синий (Blue)	0,443 – 0,546	10
Канал 3 – Зелёный (Green)	0,630 – 0,680	30 м	Канал 3 – зеленый (Green)	0,536 – 0,583	10
Канал 4 – Красный (Red)	0,630 – 0,680	30 м	Канал 4 – Красный (Red)	0,646 – 0,685	10
Канал 5 – Ближний ИК (Near Infrared, NIR)	1,560 – 1,660	30 м	Канал 5 – растительности крайний красный (Vegetation Red Edge)	0,694 – 0,713	20
Канал 6 – Ближний ИК (Short Wavelength Infrared, SWIR 2)	1,560 – 1,660	30 м	Канал 6 – растительности крайний красный (Vegetation Red Edge)	0,730 – 0,749	20
Канал 7 – Ближний ИК (Short Wavelength Infrared, SWIR 3)	2,100 – 2,300	30 м	Канал 7 – растительности крайний красный (Vegetation Red Edge)	0,766 – 0,797	20

Продолжение таблицы

Landsat-8 OLI			Sentinel-2		
Канал	Длины волн, мкм	Разрешение, м	Канал	Длины волн, мкм	Разрешение, м
Канал 8 – Панхроматический (Panchromatic, PAN)	0,500 – 0,680	15 м	Канал 8 – ближний инфракрасный (NIR)	0,763 – 0,908	10
			Канал 8A – ближний инфракрасный (Vegetation Red Edge)	0,848 – 0,881	20
Канал 9 – Перистые облака (Cirrus, SWIR)	1,360 – 1,390	30 м	Канал 9 – водяной пар (Water vapour)	0,930 – 0,958	60
Диапазоны TIRS (Thermal Infrared Sensor)					
Канал 10 – Дальний ИК (Long Wavelength Infrared, TIR1)	10,30 – 11,30	100 м	Канал 10 – облака (SWIR – Cirrus)	1,336 – 1,415	60
Канал 11 – Дальний ИК (Long Wavelength Infrared, TIR2)	11,50 – 12,50	100 м	Канал 11 – ближний инфракрасный (SWIR)	1,540 – 1,685	20
			Канал 12 – ближний инфракрасный (SWIR)	2,067 – 2,323	20

С 2018 г. снимки Sentinel-2 доступны для работы через динамический сервис изображений, который поддерживается ESRI. Сервис ежедневно обновляется новыми изображениями и позволяет работать со снимками в онлайн режиме и в настольных продуктах ArcGIS (Подключение сервиса со снимками Sentinel-2).

В качестве ЦМР использовалась цифровая модель рельефа Airbus WorldDEM4Ortho, которая является наиболее последовательной и точной спутниковой моделью рельефа в глобальном масштабе с разрешением 24 м и доступна при наличии лицензии настольных продуктов ArcGIS.

Как отмечалось ранее, для наших исследований использовались архивные и оперативные данные среднего разрешения, получаемые со спутников серии Landsat и Sentinel-2. Спектральные характеристики спутников Landsat-8 и Sentinel-2 схожи, поскольку они разрабатывались на базе тесного сотрудничества ESA и USGS (кроме тепловых каналов снимков Landsat-8 по тепловому инфракрасному датчику).

Размещение полос Sentinel-2 MSI по сравнению с 7 и 8 полосами Landsat можно увидеть на рисунке 1. Он сравнивает спектральные полосы с диапазонами ETM, Landsat OLI предоставляет два новых спектральных диапазона, один из которых предназначен специально для обнаружения перистых облаков, а другой для наблюдений в прибрежной зоне.

Исходные данные спутников Sentinel-2 предоставляются с уровнем обработки «L1C» в виде альбедо на верхней границе атмосферы (Top-Of-Atmosphere Reflectance, TOA) с выполненной радиометрической и геометрической коррекцией. Обработанные данные уровня «L2A» возможно загрузить с потока scihub, так как они были вычислены с помощью утилиты SEN2COR. Утилита позволяет выполнить атмосферную коррекцию, коррекцию рельефа и перистых облаков входных данных уровня 1C в верхней части атмосферы. Sen2Cor создает изображения нижней части атмосферы, дополнительно скорректированные на распознавание рельефа и перистых облаков; карты классификации оптической толщины аэрозоля, водяного пара, сцены и индикаторы качества для вероятности облачности и снега. Кроме того, присутствуют три диапазона файлов о качестве (QA), где один (QA60) – это диапазон битовой маски с информацией о маске облачности. Но полоса QA60 – это всего лишь двоичный классификатор для толстых облаков и перистых облаков и нет способа точно настроить, что считается облаком или не облаком и тут поможет утилита s2cloudless, которая обеспечивает вероятность присутствия облака от 0 до 100 процентов, которую можно использовать для настройки агрессивности процедуры маскирования облака. Набор данных s2cloudless дает возможность выбрать облачный порог для определения облачных / не облачных масок (Таблица 3).

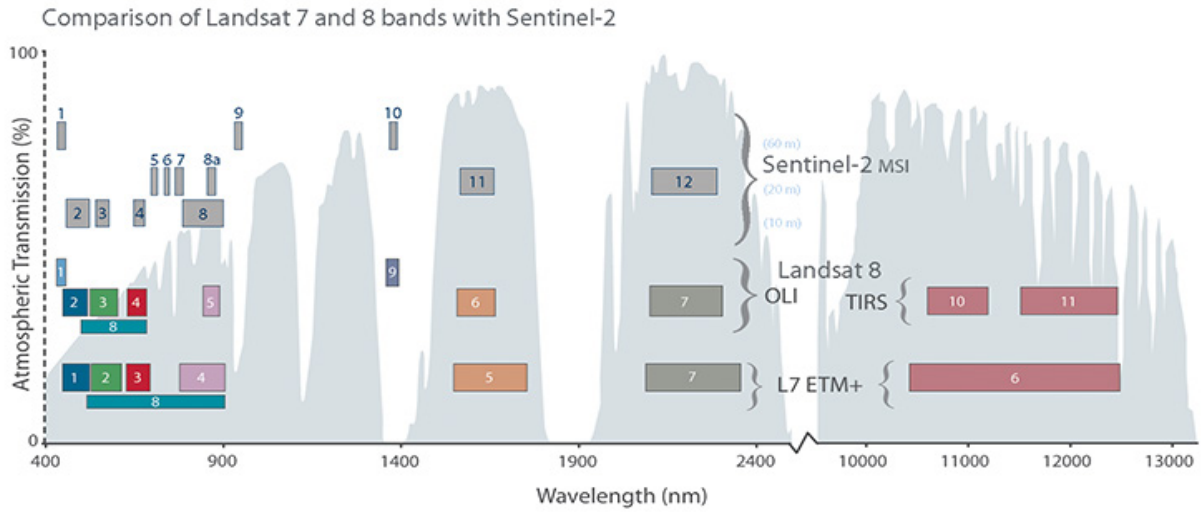


Рисунок 1 – Сравнительный график Sentinel 2, Landsat-7 и Landsat-8
(Atmospheric transmission – прозрачность атмосферы в процентах, Wavelength – длина волны в нм)

Таблица 3 – Параметры для фильтрации коллекции изображений Sentinel-2 и определения облачности и облачной тени

Параметр	Тип	Описание
AOI	ee.Geometry	Сфера интересов
START_DATE	строка	Дата начала сбора изображений (включительно)
END_DATE	строка	Дата окончания коллекции изображений (эксклюзивно)
CLOUD_FILTER	целое число	Максимальный процент облачного покрова изображений, разрешенный в коллекции изображений
CLD_PRB_THRESH	целое число	Вероятность облачности (%); значения больше, чем считаются облаками
NIR_DRK_THRESH	плавает	Отражение в ближнем инфракрасном диапазоне; значения меньше чем считаются потенциальной тенью облака
CLD_PRJ_DIST	плавает	Максимальное расстояние (км) для поиска теней от краев облаков
BUFFER	целое число	Расстояние (м) до края опознаваемых облаков объектов

Важно тщательно выбирать пороговое значение, так как оптимальное значение может варьироваться в зависимости от типа облака, типа покрытия, местоположения и т. д. Для этого необходимо протестировать несколько значений на выборке изображений в регионе исследования, чтобы получить представление о распределении вероятностей и чувствительности к изменениям.

Авторами определена методика выборки, формируются коллекции изображений, обработки данных спутников Sentinel-2 с формированием набора скриптов (Python). На рисунке 2 отображены примеры все облачные и облачно-теневые компоненты на примере Алматинской области, используя изображение s2cloudless, с установленным порогом вероятности на уровне 65% для захвата большей части облачных пикселей.

Параметры, для фильтрации коллекции изображений S2 и определения облачности и облачной тени:

```
AOI = aoi_boundary_VHB
START_DATE = ‘2020-06-20’
END_DATE = ‘2023-06-25’
CLOUD_FILTER = 60
CLD_PRB_THRESH = 50
NIR_DRK_THRESH = 0.15
CLD_PRJ_DIST = 1
BUFFER = 50
```

Утилита для построения изображений RGB с наложенной двоичной маской:

```
def overlay_cloud_mask(image, mask=None, f
actor=1./255, figsize=(15, 15), fig=None):
    if fig == None:
    plt.figure(figsize=figsize)
    rgb = np.array(image)
    plt.imshow(rgb * factor)
    if mask is not None:
    cloud_image = np.zeros((mask.shape[0], mask.
shape[1], 4), dtype=np.uint8)
    cloud_image[mask == 1] = np.asarray([255, 25
5, 0, 100], dtype=np.uint8)
    plt.imshow(cloud_image)
```

Функция полезности для построения изображения RGB и его карты вероятности облачности рядом друг с другом:

```
def plot_probability_map(rgb_image, prob_ma
p, factor=1./255, figsize=(15, 30)):
    plt.figure(figsize=figsize)
    plot = plt.subplot(1, 2, 1)
    plt.imshow(rgb_image * factor)
    plot = plt.subplot(1, 2, 2)
    plot.imshow(prob_map, cmap=plt.cm.inferno)
```

Функция для построения маски двоичного облака:

```
def plot_cloud_mask(mask, figsize=(15, 15), fi
g=None):
    if fig == None:
    plt.figure(figsize=figsize)
    plt.imshow(mask, cmap=plt.cm.gray)
```

Высокое пространственное и временное разрешение (5 дней с двумя спутниками), свободный доступ и совместимость с Landsat-8 OLI делают изображения Sentinel-2 наиболее точными и релевантными для распознавания и картирования географических объектов по исследуемой тематике. Основными источниками информации стали снимки Sentinel-2 и ЦМР Airbus WorldDEM4Ortho. Для обновления данных о географических объектах в горных районах был использован комплекс методов, основанный на обработке космических снимков.

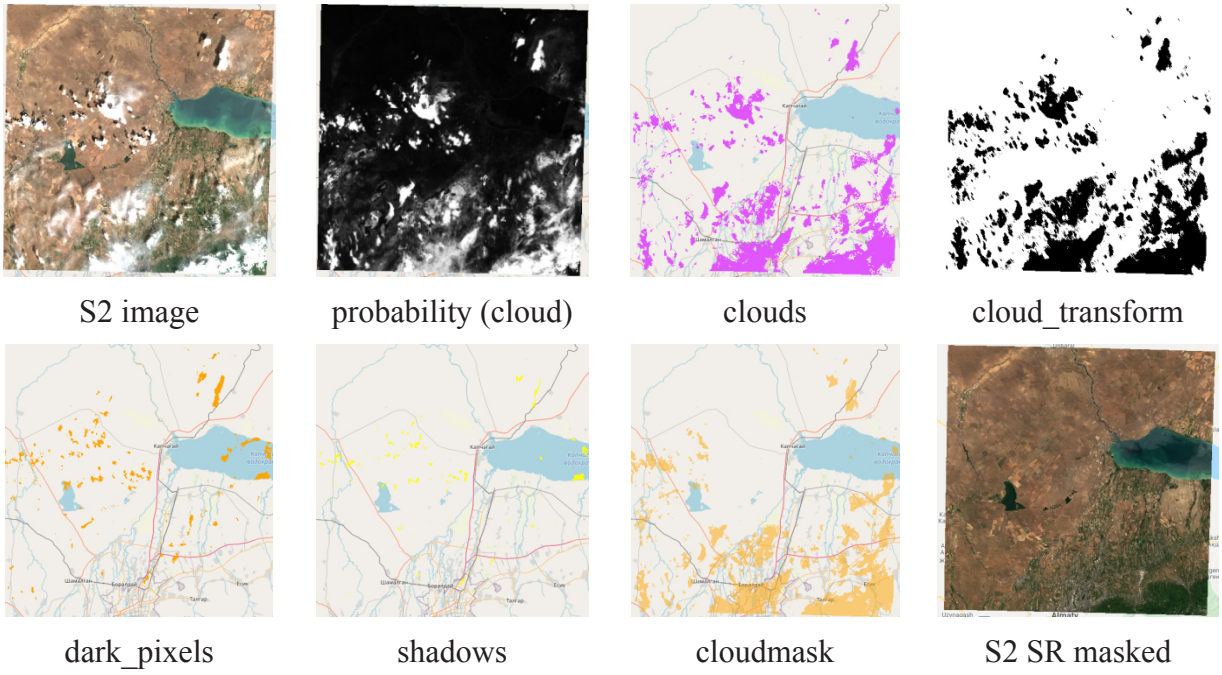


Рисунок 2 – Снимок Sentinel-2 исследуемой территории,
демонстрирующий различные типы облачного покрова и затем маскированный снимок

Результаты и обсуждение

Для выявления закономерностей формирования и распределения опасных явлений, также для решения проблем обеспечения безопасности жизнедеятельности на территориях, подверженных воздействию опасных экзогенных процессов необходимо получить объективные, актуальные, детальные данные о географических объектах. Благодаря детальной информации о рельефе, высоте, уклоне, расположении водотоков, ледников, моренных озёр, населенных пунктов, транспортной сети и других природных, антропогенных объектов, которые определяют устойчивость горных склонов и возможные опасности для людей и инфраструктуры, позволяют специалистам проводить анализ устойчивости горных склонов и выявлять потенциально опасные участки.

Данные топографических карт представляют собой важный инструмент для оценки селе-, оползне- и лавинобезопасности в горных районах. В связи с тем, что топографические карты создаются на основе определенного временного периода, а имеющиеся карты на исследуемую территорию изданы в 1975-1990 годах, они могут не отражать последние изменения в состоянии местности, в том числе водотоков и рек.

Одним из способов решения этой проблемы является использование новых и более актуальных источников данных, таких как спутниковые изображения, данные лазерного сканирования местности, также могут быть использованы векторные данные из открытых источников. Например, проверка векторных слоев проходила также путем наложения слоя со спутниковыми снимками, топографическими картами и данными открытого сервиса OpenStreetMap (OSM), который предоставляет свободный доступ к обновляемым векторным слоям базовой карты. Но при использовании векторных слоев из OSM для пространственного анализа, направленного на оценку опасных природных процессов, можно выделить несколько ключевых недостатков:

– Неполнота данных. Данные водотоков в OSM добавляются пользователями на добровольной основе. Это приводит к тому, что не все водотоки могут быть включены в базу. В результате, при анализе не учитываются важные гидрологические элементы, что снижает точность оценок;

– Непоследовательность и отсутствие стандартизации. Поскольку данные вводятся множеством различных пользователей, существует риск несоответствия стандартам. Например, один и тот же водоток может быть отмечен как «река» в одном месте и «ручей» в другом, что затрудняет обработку данных.

– Неполные атрибуты. В OSM данные часто описываются минимальным количеством атрибутов, однако для полноценного анализа опасных природных процессов требуются более детализированные данные. Недостаток таких данных может ограничить возможности анализа и прогнозирования.

– Обновление и актуальность данных. Частота обновления данных в OSM не гарантируется, и пользователи не обязаны обновлять информацию о географических объектах. Это может привести к устареванию данных, особенно в изменяющихся условиях, таких как изменения русла рек или строительство гидротехнических сооружений, которые могут значительно влиять на природные процессы.

– Отсутствие метаданных и контроля качества. В OSM часто отсутствуют детализированные метаданные, которые могли бы помочь оценить точность и надежность данных. Также отсутствует централизованный контроль качества, что может привести к появлению ошибок или неточностей в данных.

В результате работ устаревшие данные о географических объектах были обновлены, актуализированы с учетом актуальных изменений на местности, на карту были добавлены новые объекты, которые не были учтены в предыдущих версиях, верифицированы границы существующих объектов.

Векторный слой рельефа, который позволяет определить такие характеристики, как склоны и уклоны поверхности земли, является основным компонентом карт по оценке опасных природных процессов. Рельеф местности оцифрован с топографических карт масштаба 1:200 000 в виде векторных слоев точек высот, полигонов одинаковых высот. Корректировка данных слоев проводилась по цифровой модели рельефа Airbus WorldDEM4Ortho (величина ячейки □24 м), которая является наиболее последовательной и точной спутниковой моделью рельефа в глобальном масштабе с разрешением 24 м (Рисунок 3) и доступна при наличии лицензии настольных продуктов ArcGIS.

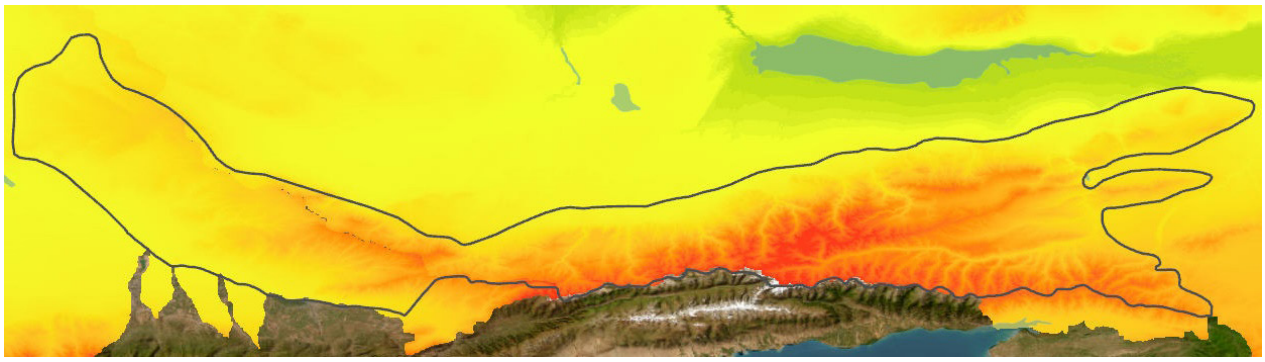


Рисунок 3 – Цифровая модель рельефа (Airbus WorldDEM4Ortho) территории ИлеАлатау

Пространственные данные по гидрографической сети, водосборным площадям водотоков созданы путем многоэтапной обработки ЦМР, с использованием комплекса специальных дополнительных инструментов, модулей и расширений настольных пакетов ArcGIS. Современный инструментарий ГИС позволяет определить гидрографические и морфометрические характеристики водных объектов и их водосборов при наличии корректной ЦМР.

Слой «Гидрографическая сеть» проектной территории создавался методом автоматизированного извлечения водотоков на основе применения открытого набора инструментов модуля ArcHydro расширения HEC-GeoHMS и WhiteboxTools-ArcGIS и ЦМР, широко используемых в ГИС-картографировании и гидрологии при определении гидрографических и морфометрических характеристик территории, границ водосборов .

Полученный на данном этапе результат является первичным слоем водотоков, который должен пройти проверку и анализ на ряд ошибок, а также дополнительную обработку для получения корректной сети водотоков. При необходимости, исправления вносятся вручную.

В результате обработки и исправления векторного слоя водотоков по топокарте (1:100 000) и космоснимкам Sentinel-2 создается корректная гидрографическая сеть территории (Рисунок 4).

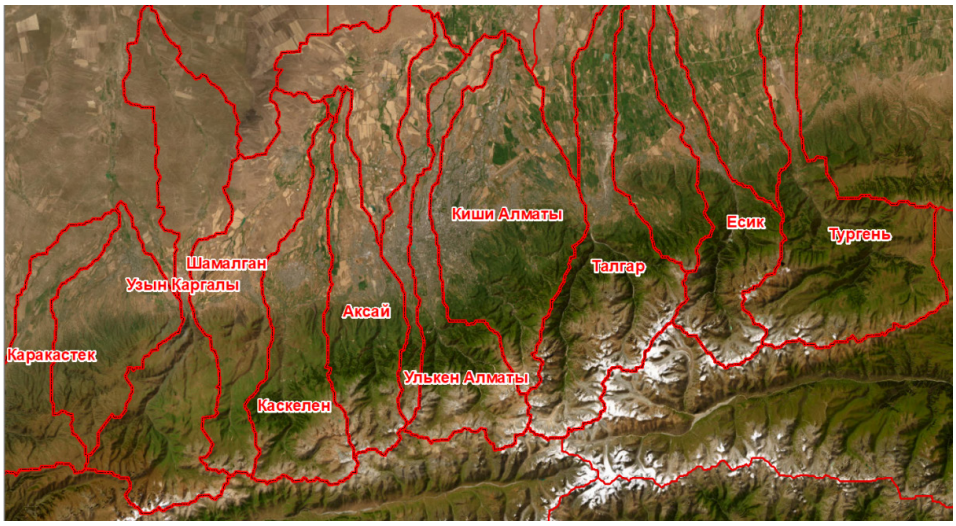
Оцифровка пространственных данных по ледникам и по моренным озерам проводилась по топографическим картам, корректировка контуров для отображения современного состояния – по спутниковым снимкам Sentinel 2 (Рисунок 5 и Рисунок 6)

Созданные слои отображают актуальное пространственное распределение ледников и моренных озёр на 2023 год.

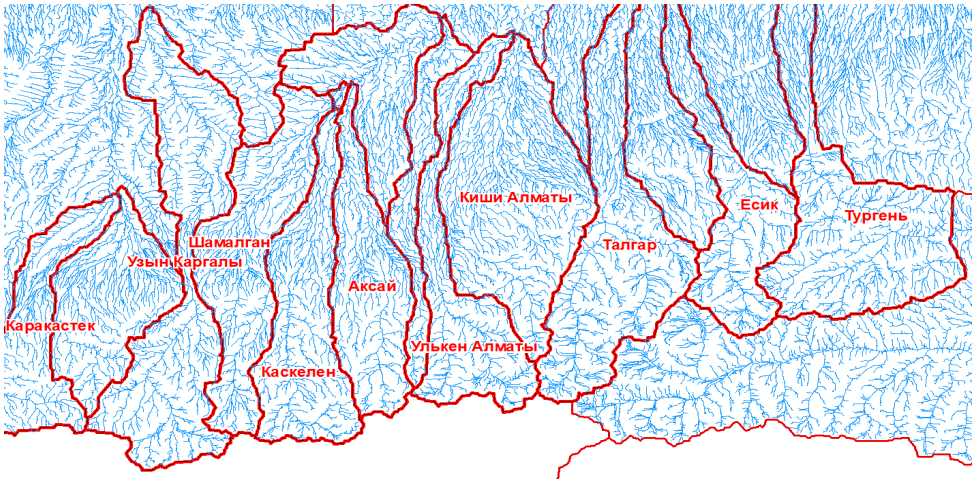
Информация о географическом расположении и характеристиках ледников, а также моренных озер позволяет проводить анализ и прогнозирование потенциально опасных природных процессов, определить потенциально опасные зоны, разработать меры предотвращения и соответствующие планы действий для обеспечения безопасности людей и имущества.

Рост числа и протяжённости автомобильных дорог относится к ряду приоритетных мероприятий по модернизации республиканских и региональных транспортных систем. Транспортная сеть показывает степень заселенности территории, дает представление об экономической жизни в регионе, доступность каждого населенного пункта, изображенного на карте, отражает возможность передвижения с учетом местных природных особенностей. Актуализация геопространственных данных по изменениям в конфигурации транспортной сети является жизненно необходимой при разработке стратегии и плана действий при возникновении ЧС природного и антропогенного характера.

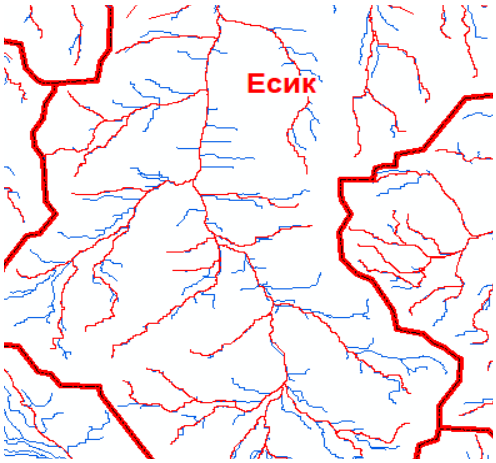
На рисунке 7 показан пример использования космических снимков Sentinel-2 для обновления векторного слоя по транспортной сети. На исследуемой территории в 2022 г. была построена новая развязка Большой алматинской кольцевой автомобильной дороги, отсутствовавшая по данным космоснимков Sentinel-2 2018 года.



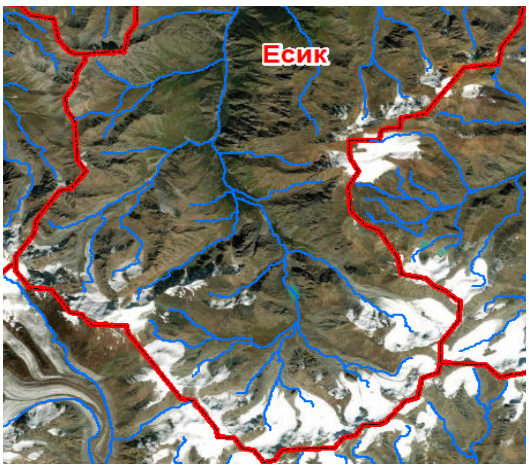
а) Фрагмент векторного слоя водосборных площадей водотоков горных районов Иле Алатау



б) Фрагмент первичного слоя водотоков исследуемой территории.



в) Фрагмент первичного слоя водотоков, без исправления



г) Фрагмент исправленного слоя водотоков

Рисунок 4 – Фрагменты векторных слоев водосборных площадей водотоков и рек проектной территории

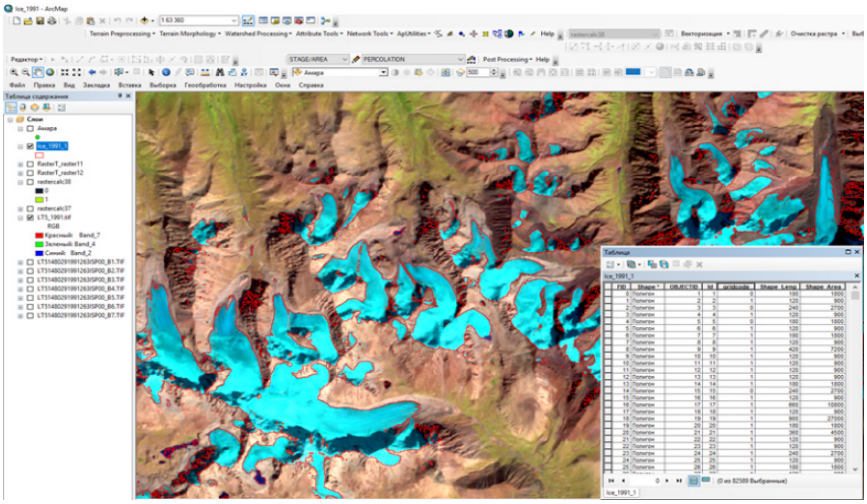


Рисунок 5 – Векторный полигональный слой по ледникам

Рисунок 6 – Использование космических снимков Sentinel-2
для обновления тематического слоя по моренным озерам

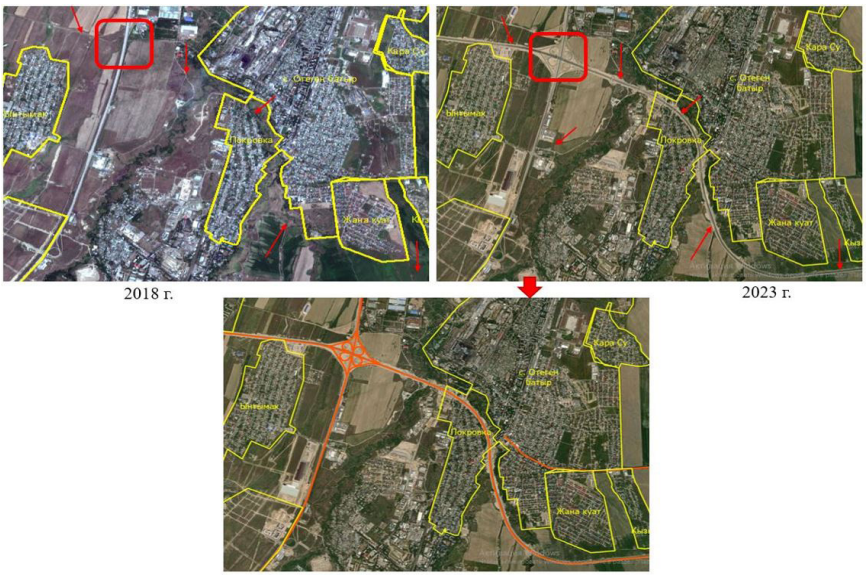


Рисунок 7 – Использование космических снимков Sentinel-2 для актуализации транспортной сети
(БАКАД – Новая Большая алматинская кольцевая автомобильная дорога)

Населенные пункты являются одним из основных элементов содержания тематических карт по оценке опасности и риска селевых, оползневых и лавинных процессов в горных районах. Для создания векторного слоя населенных пунктов исследуемой территории за основу использовался слой населенных пунктов набора данных OpenStreetMap (OSM), в котором обнаружены ошибки, связанные с границами и количеством, названиями объектов. Актуализация границ объектов слоя населенных пунктов проводилась по оперативным данным ДЗЗ (Рисунок 8).

а) Село Аркабай: розовым – объект в слое OSM, желтым – актуализированный по спутниковым снимкам объект

б) Зона отдыха «Лесная Сказка: розовым – OSM, зеленым – актуализированный по спутниковым снимкам объект

в) Дачи Жетысу: в слое набора OSM отсутствовали

Рисунок 8 – Использование космических снимков (Sentinel-2) для актуализации территорий населенных пунктов

Использование данных космических снимков позволяет применить актуальную детальную информацию при картографировании и последующем анализе динамики и тенденций изменения природных и социально-экономических объектов. Использование данных ДЗЗ позволяет проводить регулярный мониторинг и анализ опасных процессов в горных районах, в импактной зоне которых могут оказаться уязвимые объекты социальной, транспортной и экономической инфраструктуры.

Заключение

Информация о природных и социально-экономических объектах в горных и предгорных районах была обновлена с помощью визуальной и автоматизированной обработки космических снимков, многоэтапной обработки ЦМР. Результат выполненных работ стал возможным на основе тщательного изучения современных систем ДЗЗ, сравнительного анализа и выбора космических снимков Sentinel 2, Landsat-8 как наиболее релевантных поставленным задачам.

Для актуализации тематических векторных слоев картографической основы исследуемой территории были использованы архивные и оперативные данные среднего разрешения, получаемые со спутников серии Landsat-8 и Sentinel-2, также ЦМР Airbus WorldDEM4Ortho. Для фильтрации коллекции изображений Sentinel-2 и определения облачности и облачной тени сформирован набор скриптов Python.

Использование космических снимков в комплексе с корректной ЦМР позволило получить точные и актуальные данные, на основе которых созданы обновлённые тематические слои «Гидрографическая сеть», «Ледники», «Моренные озёра», «Транспортная сеть», «Населённые пункты». Действия по обработке и интерпретации данных ДЗЗ позволили охватить обширные и труднодоступные территории горных районов, значительно снизить затраты на сбор и обработку данных.

Обновленная информация о географических объектах может быть использована для создания карт по опасным природным процессам, планирования и развития инфраструктуры, мониторинга изменений окружающей среды, при разработке защитных мероприятий при ЧС природного и антропогенного характера.

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Литература

Абиева Д.К., Карагулова Р.К., Аюпов К.А., Толепбаева А.К., Уразбаева Г.М. Анализ пригодности наборов данных глобальных исследований поверхностных вод (Global Surface Water) для изучения динамики площадей озер Казахстана // География и водные ресурсы. – 2020. – №. 3. – С. 33-42.

Антонов С.А., Скрипчинский А.В. Использование данных дистанционного зондирования для многолетнего мониторинга за состоянием агроландшафтов // Наука. Инновация. Технологии, – 2018. – №8. – С. 89–100.

Загрузка сцен Sentinel-2 на определенную территорию [Электронный ресурс]/Сайт Data+. URL: https://blogs.esri-cis.com/2021/05/13/sentinel-2-download/(дата обращения 05.03.2024).

Каналы Landsat 8: Комбинации для спутниковых снимков [Электронный ресурс]/Сайт EOS Data Analytics. URL: https://eos.com/ru/blog/kombinatsii-kanalov-landsat-8/(дата обращения 07.02.2024).

Комарова А.Ф. Открытые мультиспектральные данные и основные методы дистанционного зондирования в изучении растительного покрова // Принципы экологии. – 2016. – № 1. – С. 40–47.

Манилюк Т. Л., Маслова Л. В. Исследование водных поверхностей озер путем использования водных индексов по данным дистанционного зондирования //Вестник Забайкальского государственного университета. – 2017. – Т. 23. – №. 3. – С. 4-11.

Рамазанова Б.К., Касымжанова А.Е. Оптические методы съемки дистанционного зондирования Земли // Наука сегодня: Проблемы и пути решения. – 2018. – С. 81-82.

Толепбаева А.К., Тұмажанова С.О., Карагулова Р.К., Танбаева А.А., Искалиева Г. М. Жерді қашықтықтан зондтау негізіндегі ғаламдық деректер базасы: Ертіс өзені жайылмасының мысалында//Вестник КазНУ. Серия географическая. – №2, 57 (2020):16-25.

Airbus WorldDEM4Ortho in ArcGIS Living Atlas of the World [Электронный ресурс]/Сайт Esri. URL: https://www.esri.com/arcgis-blog/products/arcgis-living-atlas/imagery/airbus-worlddem4ortho-in-arcgis-living-atlas-of-the-world/ (дата обращения 05.03.2024).

Cheng G., Han J. (2016) A survey on object detection in optical remote sensing images. ISPRS J. Photogramm. Remote Sens. 117, 11–28. doi.org/10.48550/arXiv.1603.06201

Jeffrey P., Tyukavina A., Khan A., Potapov P., Adusei B., Matthew C. H., Lima A. (2021). Using Multi-Resolution Satellite Data to Quantify Land Dynamics: Applications of PlanetScope Imagery for Cropland and Tree-Cover Loss Area Estimation. *Remote Sens.* 13 (11), 2191. doi.org/10.3390/rs13112191

Landsat-8 [Электронный ресурс]/Сайт геопространственного агентства «ИННОТЕР». URL: https://innoter.com/sputniki/landsat-8/ (дата обращения 02.02.2024).

Lim S., Sreevalsan-Nair J., Daya Sagar B. S. (2023). Multispectral data mining: A focus on remote sensing satellite images. Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery. 10.1002/widm.1522.

Priyabrata K., Shyh W.T., Manzur M., Shaoning P., Li Y., Hao L. (2024). Crop monitoring by multimodal remote sensing: A review. Remote Sensing Applications: Society and Environment Remote Sens. Appl.: Society and Environment. 33, 101093. doi.org/10.1016/j.rsase.2023.101093

Data collections. Sentinel data [Электронный ресурс]/Сайт Programme of the European Union – Copernicus. URL: https://dataspace.copernicus.eu/explore-data/data-collections (дата обращения 04.03.2024).

Sentinel-2 [Электронный ресурс]/Сайт Data+. URL: https://blogs.esri-cis.com/tag/sentinel-2/ (дата обращения 04.03.2024).

Sentinel-2A, 2B [Электронный ресурс]/Сайт геопространственного агентства «ИННОТЕР». URL: https://innoter.com/sputniki/sentinel-2a-2b/ (дата обращения 03.03.2024).

Sinčić M., Bernat G.S., Krkač M., Lukačić H., Mihalić A.S. (2022). The Use of High-Resolution Remote Sensing Data in Preparation of Input Data for Large-Scale Landslide Hazard Assessments. *Land, 11(8),* 1360. doi.org/10.3390/land11081360

Sreenivasan. G., Murthy Y. (2018). Remote Sensing and GIS Applications in Micro Level Planning. 29, 603-631. doi.org/10.1007/978-3-319-78711-4_29.

USGS EROS Archive – Sentinel-2 – Comparison of Sentinel-2 and Landsat [Электронный ресурс]/Сайт USGS. URL: https://www.usgs.gov/centers/eros/science/usgs-eros-archive-sentinel-2-comparison-sentinel-2-and-landsat?qt science_center_objects=0#qt-science_center_objects (дата обращения 03.03.2024).

References

Abiyeva, D.K., Karagulova, R.K., Ayupov, K.A., Tolepbayeva, A.K., Urazbayeva, G.M. (2020). Analiz prigodnosti naborov dannykh globalnykh issledovaniy poverkhnostnykh vod (Global Surface Water) dlya izucheniya dinamiki ozernykh ploshchadey v Kazakhstane [Analysis of the suitability of global surface water data sets for studying lake dynamics in Kazakhstan]. Questions of geography and geoecology, Vol. (3), 33-42.

Airbus WorldDEM4Ortho in ArcGIS Living Atlas of the World [Electronic resource]/ Esri. URL: https://www.esri.com/arcgis-blog/products/arcgis-living-atlas/imagery/airbus-worlddem4ortho-in-arcgis-living-atlas-of-the-world/ (date of access 05.03.2024)

Antonov, S.A., Skripchinskiy, A.V. (2018). Ispolzovaniye dannykh distantsionnogo zondirovaniya Zemli dlya mnogoletnego monitoringa sostoyaniya agrolandshaftov [Using Earth remote sensing data for long-term monitoring of agricultural landscapes]. “Science. Innovations. Technologies, Vol. (8), 89–100.

Cheng G., Han J. (2016) A survey on object detection in optical remote sensing images. ISPRS J. Photogramm. Remote Sens. 117, 11–28. doi: 10.48550/arXiv.1603.06201

Data collections. Sentinel data [Electronic resource]/ Programme of the European Union – Copernicus. URL: https://dataspace.copernicus.eu/explore-data/data-collections (date of access 04.03.2024).

Jeffrey P., Tyukavina A., Khan A., Potapov P., Adusei B., Matthew C. H., Lima A. (2021). Using Multi-Resolution Satellite Data to Quantify Land Dynamics: Applications of PlanetScope Imagery for Cropland and Tree-Cover Loss Area Estimation. *Remote Sens.* 13 (11), 2191. doi: 10.3390/rs13112191

Komarova, A.F. (2016). Otkrytyye multispektralnyye dannyye i osnovnyye metody distantsionnogo zondirovaniya v izuchenii rastitelnogo pokrova [Open Multispectral Data and Key Remote Sensing Methods in Land Cover Studies]. Principles of the Ecology, Vol. (1), 40–47.

Landsat 8 Bands: Combinations For Satellite Images [Electronic resource]/ EOS Data Analytics. URL: https://eos.com/ru/blog/kombinatsii-kanalov-landsat-8/(date of access 07.02.2024).

Landsat-8 [Electronic resource]/ Geospatial Agency Innoter. URL: https://innoter.com/sputniki/landsat-8/ (date of access 02.02.2024).

Lim S., Sreevalsan-Nair J., Daya Sagar B. S. (2023). Multispectral data mining: A focus on remote sensing satellite images. Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery. doi: 10.1002/widm.1522.

Loading Sentinel-2 scenes into a specific area [Electronic resource]/Data+. URL: https://blogs.esri-cis.com/2021/05/13/sentinel-2-download/(date of access 05.03.2024).

Manilyuk, T. L., Maslova, L. V. (2017). Issledovaniye vodnoy poverkhnosti ozer s ispolzovaniyem pokazateley vody po dannym distantsionnogo zondirovaniya [Study of the water surface of lakes using water indicators from remote sensing data]. Transbaikal state university journal, Vol. (23), 4-11.

Priyabrata K., Shyh W.T., Manzur M., Shaoning P., Li Y., Hao L. (2024). Crop monitoring by multimodal remote sensing: A review. Remote Sensing Applications: Society and Environment, 33, 101093. doi: 10.1016/j.rsase.2023.101093

Ramazanova, B.K., Kasymzhanova, A.Ye. (2018). Optical methods of remote sensing of the Earth. Proceedings of the international scientific and practical conference “Science of today’s problems and solutions”, 81-82.

Sentinel-2 [Electronic resource]/Data+. URL: https://blogs.esri-cis.com/tag/sentinel-2/ (date of access 04.03.2024).

Sentinel-2A, 2V [Electronic resource]/ Geospatial Agency Innoter. URL: https://innoter.com/sputniki/sentinel-2a-2b/ (date of access 03.03.2024).

Sinčić M., Bernat G.S., Krkač M., Lukačić H., Mihalić A.S. (2022). The Use of High-Resolution Remote Sensing Data in Preparation of Input Data for Large-Scale Landslide Hazard Assessments. *Land, 11(8),* 1360. doi: 10.3390/land11081360

Sreenivasan. G., Murthy Y. (2018). Remote Sensing and GIS Applications in Micro Level Planning. 29, 603-631. doi: 10.1007/978-3-319-78711-4_29.

Tolepbayeva, A.K., Tumazhanova, S.O., Karagulova, R.K., Tanbayeva, A.A., Iskaliyeva, G. M. (2020). Globalnaya baza dannykh na osnove distantsionnogo zondirovaniya Zemli: na primere razliva reki Irtysh [Global database based on remote sensing of the Earth: the example of the Irtysh River flood]. Journal of Geography and Environmental Management, Vol. (2-57), 6-25.

USGS EROS Archive – Sentinel-2 – Comparison of Sentinel-2 and Landsat [Electronic resource]/ USGS. URL: https://www.usgs.gov/centers/eros/science/usgs-eros-archive-sentinel-2-comparison-sentinel-2-and-landsat?qt science_center_objects=0#qt-science_center_objects (date of access 03.03.2024).

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3-бөлім

МЕТЕОРОЛОГИЯ ЖӘНЕ ГИДРОЛОГИЯ

Section 3

METEOROLOGY AND HYDROLOGY

Раздел 3

МЕТЕОРОЛОГИЯ И ГИДРОЛОГИЯ

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SPATIO-TEMPORARY CLIMATE VARIABILITY AND THEIR MANIFESTATIONS IN THE WATERSHED OF THE ASSA-TALAS RIVER BASIN

To predict current climate changes and their manifestations in the watershed of the Assa-Talas river basin, a research base has been created based on many years of information and analytical materials from RSE «Kazhydromet» and «Kyrgyzhydromet», the World Meteorological Organization (WMO), the reference and information portal «Weather and Climate», allowing to study trends on a spatio-temporal scale. Based on the established research base for the weather stations Susamyr, Talas, Kyzyl-Adyr, Nurlykent, Taraz, Saudakent and Oyyk, located in the catchment areas of the Assa-Talas river basin, graphs of time series of average annual air temperatures and annual precipitation amounts were constructed using classical and modern methods mathematical statistics based on standard application packages of digital technology and equations of their linear trend were obtained, which made it possible to develop a mathematical model of the growth rate of climatic and hydrological indicators, which has a fairly high physical and mathematical meaning, based on the law of nature.

An analysis of the growth rate of climatic indicators in the catchment area of the Assa-Talas River basin shows that their quantitative values for all meteorological stations do not coincide, that is, in modern conditions, the growth rate of average annual air temperatures in comparison with the growth rate of annual precipitation is twice as high, which contributes to increasing the shortage of water consumption of natural and cultivated agricultural land up to 25% and reducing the surface hydrological runoff up to 15% in comparison with the middle of the twentieth century, ensuring the water security of the region.

Key words: climate, forecast, change, air temperature, precipitation, linear trend, growth rate, model, law.

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Асса-Талас өзенінің су жинау алабындағы климаттың кеңістіктік-уақыттық өзгергіштігі және оның аймақтағы көріністері

Асса-Талас өзенінің су жинау алабындағы климаттың өзгеру бағыты және оның аймақтағы көріністерін уақыт-кеңістік масштабында бағдаралау мақсатында «Қазгидромет» және «Қырғызгидромет» РМӨ-нің, Бүлікәлемдік Метеорологиялық Ұжымның (БМҰ) және «Ауа-райы және климат» анықтамалық-ақпараттық порталдың көпжылдық ақпараттық-талдау мәліметтерінің негізінде, зерттеу қоры құрылған. Асса-Талас өзенінің су жинау алабының аймағында орналасқан Сусамыр, Талас, Қызыл-Адыр, Нұрлыкент, Тараз, Саудакент және Ойық метеорологиялық бекеттер бойынша құрылған зерттеу қорының негізінде, стандартық цифрлық технологияларды қолдану бағдарламаларының пакеттеріне негізделген математикалық статистиканың классикалық және заманауи әдістерін пайдалану арқылы, орташа жылдық ауа температурасы және жылдық атмосфералық жауын-шашынның уақытша қатарының сызбалық сұлбасы тұрғызылған және жоғары дәрежедегі физикалық және математикалық мағанаға ие, табиғи заңдылықтарға негізделіп құрылған сызықтық трендтердің теңдеулердің негізінде, климаттық және гидрологиялық көрсеткіштердің өсу қарқынының математикалық моделі құрылды. Асса-Талас өзенінің су жинау алабының аймағындағы климаттық көрсеткіштердің өсу қақынынына

көрсеткендей, қарастырылып отырылған барлық метеорологиялық бекеттерде, олардың сандық мәні бірдей емес, яғни қазіргі кездегі орташа жылдық ауа температурасы өсу қарқыны, жылдық атмосфералық жауын-шашынның өсу қарқынымен салыстырғанда екі есе жоғары болғандықтан, ол XX ғасырдың ортасымен салыстырғанда, аймақтың су ресурстарымен қамтамасыз ету дәрежесіне әсер етіп, табиғи және мәдени ауылшаруашылық егістік жерлерді жетіспейтін суды тұтыну шамасын 25% өсуіне және жер беті гидрологиялық ағындардың шамасын 15 % төмендеуіне алып келуі мүмкін.

Түйін сөздер: климат, бағдарлама, өзгеру, ауа температурасы, атмосфералық жауын-шашын, сызықтық тренд, өсу қарқыны, моделі, заңдылық.

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Пространственно-временная изменчивость климата и их проявления на водосборе бассейна реки Асса-Талас

Для прогноза современных изменений климата и их проявления на водосборе бассейна реки Асса-Талас создана база исследований, на основе многолетних информационно-аналитических материалов РГП «Казгидромет» и «Кыргызгидромет», Всемирной Метеорологической Организации (ВМО) и справочно-информационного портала «Погода и климат», позволяющих изучить тенденции в пространственно-временном масштабе. На основе созданной базы исследования по метеорологическим станциям Сусамыр, Талас, Кызыл-Адыр, Нурлыкент, Тараз, Саудакент и Ойык, расположенных на водосборных территориях бассейна реки Асса-Талас, с использованием классических и современных методов математической статистики, основанных на стандартных пакетах прикладных программ цифровой технологии, построены графики временного ряда среднегодовых температур воздуха и годовых атмосферных осадков и, получены уравнения их линейного тренда, которые позволили разработать математическую модель темпа прироста климатических и гидрологических показателей, имеющих достаточно высокий физический и математический смысл, базирующихся на законе природы. Анализ темпа роста климатических показателей на территории водосбора бассейна реки Асса-Талас показывает, что их количественные значения по всем метеорологическим станциям не совпадает, то есть в современных условиях темп прироста среднегодовых температур воздуха в сравнении темпа роста годовых атмосферных осадков в два раза больше, который способствует повышению дефицита водопотребления естественных и культурных сельскохозяйственных угодий до 25% и уменьшению поверхностного гидрологического стока до 15 % в сравнение середине XX века, обеспечивающих водную безопасность региона.

Ключевые слова: климат, прогноз, изменение, температура воздуха, атмосферные осадки, линейный тренд, темп прироста, модель, закон.

Introduction

Features of the formation of surface runoff, soil and vegetation cover of watersheds of river basins are mainly determined by the climatic factor, that is, the average annual air temperatures and annual precipitation, characterizing their heat and moisture supply, performing the functions of environment formation. In this regard, a comprehensive assessment of climate change in the catchment areas of river basins on a spatio-temporal scale, characterizing the activities of the natural system, is the main issue of water supply and the development trend of this process. At the same time, the need to study modern climate change is due to insufficient knowledge of their watershed areas of the Assa-Talas river basin and practical needs for reliable information on the state of the temperature and humidity regime on a spatio-temporal scale that affects the evolution of natural conditions for the formation of the productivity of landscape ecosystems.

The purpose of the study is explore the trend of climate change in the catchment areas of river basins on a spatio-temporal scale to form a research base, for the natural and climatic orientation of their environment-forming activities.

The object of research is the catchment area of the Assa-Talas river basin located in the northwest of the Kyrgyz Republic and southwest of the Republic of Kazakhstan. The Talas River is formed at the confluence of the Karakol and Uchkoshoy rivers, which form at the junction of the Kirghiz and

Talas ridges, in the lower reaches it is lost in the Muyunkum sands. The length of the Talas River is 661 km, the catchment area is 52,700 km². The river Assa originates from the confluence of the Kurkureu – Suu rivers, originating on the northern slope of the Talas Ala- Too and Ters, formed on the southeastern slope of Asa Karatau, the length of which is 253 km and the catchment area is 6670 km ^{2,} is the left tributary of the Talas River and flows into the desert reservoir in the Muyunkum sands (Mustafayev Zh.S. et al., 2022).

Materials and research methodology

To form the research base, long-term information and analytical materials of the Republican State Enterprise «Kazhydromet» (Scientific and applied reference book on the climate of the USSR, 1989) and «Kyrgyzhydromet» (Scientific and applied reference book on the climate of the USSR: Kirghiz SSR, 1989), the World Meteorological Organization (WMO; https://public.wmo.int/en) and the reference and information portal "Weather and Climate" (www.pogodaiklimat.ru) located on the watersheds of the Assa-Talas River basin of the meteorological stations Susamyr, Talas, Kyzyl-Adyr, Nurlykent, Taraz, Saudakent and Oyik, which are more than 81 years and include years with different natural and climatic conditions.

The assessment and determination of all statistical parameters of linear trends in the time series of climate indicators were carried out using classical and modern methods of mathematical statistics, based on standard digital technology application software packages.

Analysis of recent research and publications on the issue of climate change. There is a large number of works carried out in various continents of the globe, the administrative territories of individual countries and the catchment areas of river basins, among which the following works should be highlighted:

- Salma Khalid, Salahuddin Azad, Alia Naz, Zia ur Rahman and Arshad Iqbal (Khalid, S. et al., 2017), Barry R.G. (Barry R.G., 2001), Bhutiyani M., Kale V. and Pawar N. (Bhutiyani M. et al., 2010), Dash S., Jenamani R., Kalsi S. and Panda S. (Dash S. et al., 2007), Shrestha A.B. and Aryal R. (Shrestha A., Aryal R., 2011), where both surface and ocean temperature changes, extreme weather events, glacier melt and sea level rise, water quality and crop management practices are widely attributed to both short-term and long-term climate change, with particular emphasis on South Asia and Pakistan, India, Mongolia and the Himalaya mountain ranges;

- Mokhov I.I (2019), Kadioğlu M. (1997), where the trends of modern and regional climate changes are described using long-term data from the Arctic and various regions of Russia, Turkey using linear trends and their consequences in the 21st century;

- Hanski I. (2005), Holten J.I. (1993), where the impact of climate change on landscape fragmentation, the distribution of plant species and the natural ecosystems of Europe was studied;

- Karl T.R. and Trenberth K.E. (2003), Kawahara M. and Yamazaki N. (1999), Kaser G., Hardy D.R., Mölg T., Bradley R.S. and Hyera T.M. (Kaser G. et al., 2004), Markham A. (1996), Muhammed A., Stewart B.A., Mitra A., Shrestha K.L., Ahmed A.U. and Chowdhury A. (Muhammed A. et al., 2004) where the problems of modern climate change and their influence on the natural system of America, Japan, glaciers are considered Kilimanjarai water resources formation South Asia.

According to the results of the analysis of studies conducted in various continents of the globe, the administrative territories of individual countries and the drainage areas of river basins, it can be stated that the direction and intensity of changes in climate indicators are not the same and the conclusions are very contradictory due to the conditions for the formation of natural systems that determine the scientific and practical feasibility of their study, to create a regional base for climate research.

Research results

The climate, as a long-term regime of weather factors inherent in the geographical zones of the Planet, performing special functions – runoff formation, biomass production, soil formation and human habitat, has direct and inverse relationships in natural processes that require analysis and evaluation on a spatio-temporal scale. This functional activity of the climate determines the scientific and practical feasibility of studying the trend of climate change in order to identify their favorable and negative impacts, taking into account the interests of environmental management and nature management.

Currently natural the system has entered the active stage of "succession", i.e. the successive regular replacement of one biological community by another in connection with global climate change, within which it is possible to assess climate change in the watersheds of river basins, which are the spatial bases of nature management, requires the need

to determine their favorable or negative impacts at the level of water and food security and the safety of society.

For the analysis and assessment of the climate change trend, the mean annual air temperatures (t,°C), characterizing energy resources ($\sum t > 10$°C = f(t)) and being a function of the evaporating (E_o = f(t)) capacity of the natural system and annual precipitation (O_c), which are the incoming part of the water balance of the Earth's day surface, as well as the linear trend method, which is written as a linear regression equation with two free numerical indicators:

$$y(n) = a_o + a_i \cdot n, \quad (1)$$

where $y(n)$ is the calculated value of the observation index; n is the ordinal number of the observed value; a_o and a_i – regression coefficients or a free numerical indicator.

Depending on the long-term regime of climatic indicators, that is, the average annual air temperatures (t,°C) and annual precipitation (O_c), occur in nature in the form of an increase or decrease in a linear trend characterizing the trend in changes in climatic indicators:

- positive – $t_i = a_i \cdot n_i + a_o$ and $O_{ci} = a_i \cdot n_i + a_o$;
- negative – $t_i = -a_i \cdot n_i + a_o$ and $O_{ci} = -a_i \cdot n_i + a_o$ or $-t_i = a_i \cdot n_i - a_o$ and $O_{ci} = a_o \cdot n_i - a_o$.

The study of the climate change trend in the catchment area of the Assa-Talas river basin as a model of river basins with diverse natural and climatic areas was carried out on the basis of geomorphological schematization characterizing catenary patterns (Table 1).

Table 1 – Natural and climatic zones of zoning of the catchment area of the Assa-Talas river basin based on geomorphological schematization

Natural and climatic zones		Weather station	Terrain altitude (m)
landscape class	catenary facies		
Mountain	Eluvial	Susamyr	2092.0
Foothill	Transeluvial	Talas	1218.0
foothill plain	Transaccumulative	Nurlykent	954.0
		Kyzyl-Adyr	824.0
		Taraz	655.0
southern desert	Superaqueous	Saudakent	338.0
		Oyik	336.0

Based on the created research base for the meteorological stations Susamyr, Talas, Kyzyl-Adyr, Nurlykent, Taraz, Saudakent and Oyik (Table 1), located in the catchment area of the Assa-Talas river basin using the Microsoft program Excel plots of the time series of average annual air temperatures and annual precipitation were constructed and the equations of their linear trend were obtained (Table 2, Figures 1-4).

An analysis of the long-term course of changes in climatic indicators at the Susamyr meteorological station located in the mountainous zone (eluvial facies) of the Assa-Talas river basin and its climate model indicates that for the period under consideration 1940-2020, the change in average annual air temperatures (Table 2 and Figure 1) for 81 years is 2.6180 °C with an intensity of 0.032 °C/year and annual precipitation (Table 2 and Figure 2) decreases by 36.2640 mm from 0.45 mm/year.

An analysis of the dynamics of climatic indicators for the Talas meteorological station (Table 2 and Figure 3), located in the foothill zone (transeluvial facies) of the Assa-Talas river basin, and its climate model showed that in the study area for the period under consideration of 1940-2020, changes in average annual air temperatures (Table 2 and Figure 3) for 81 years, it increased by 2.3840 °C with an intensity of 0.029 °C/year and annual precipitation increases by 24.400 mm from 0.30 mm/year.

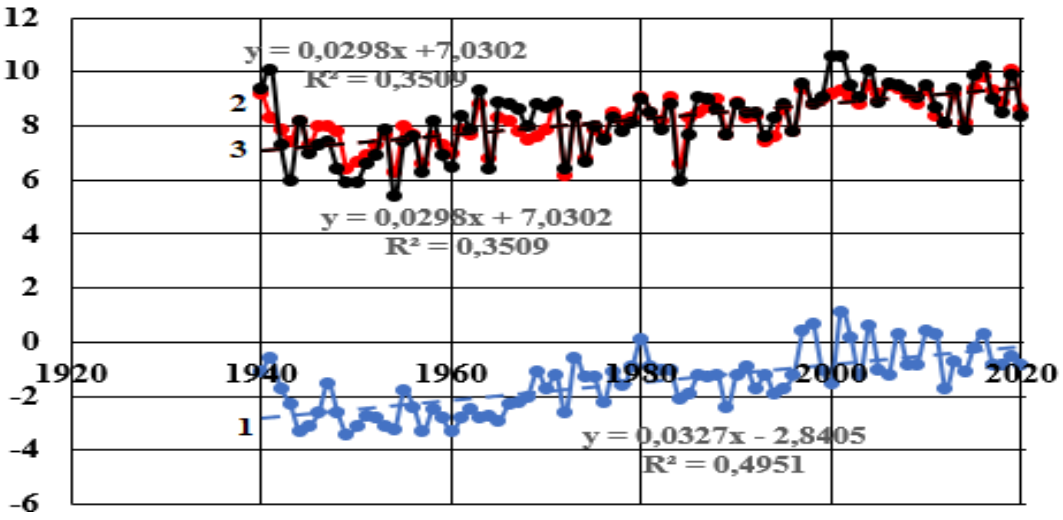

Figure 1 – Graph of changes in the average annual air temperatures of the mountain (1 – meteorological station Susamyr), foothill (2 – meteorological station Talas) and foothill plains (3 – meteorological station Kyzyl- Adyr) zones (ordinate – average annual air temperature; abscissa – years) for 1940-2020 and their linear trend

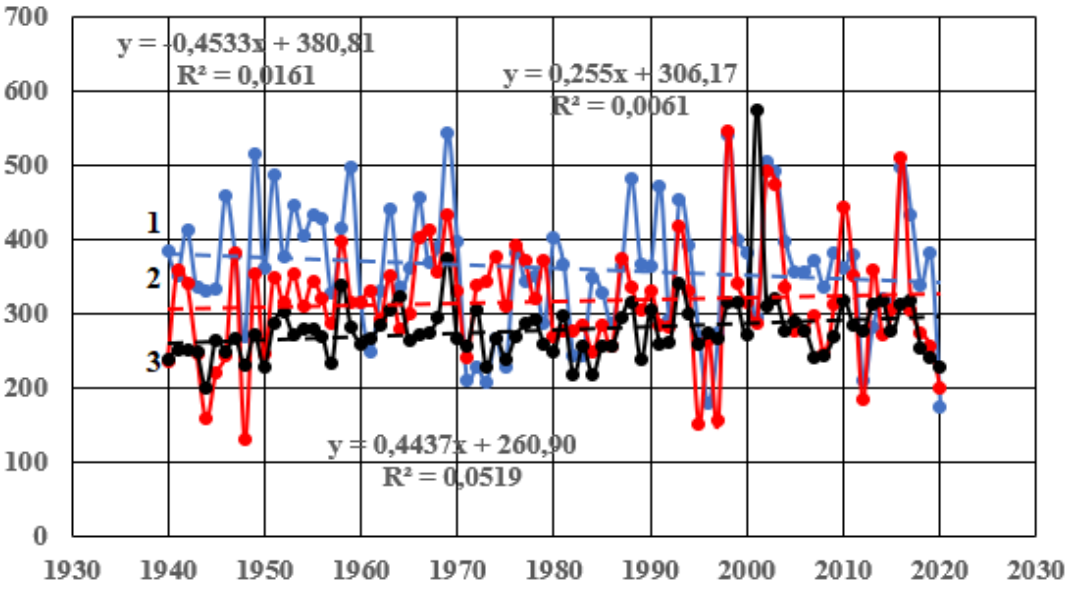

Figure 2 – Annual change chart precipitation mountainous (1- meteorological station Susamyr), foothill (2- meteorological station Talas) and foothill plain (3- meteorological station Kyzyl- Ardyr) zones (ordinate – average annual air temperature; abscissa – years) for 1940-2020 and their linear trend

An analysis of the dynamics of climatic indicators for the Talas meteorological station (Table 2 and Figure 3), located in the foothill zone (transeluvial facies) of the Assa-Talas river basin, and its climate model showed that in the study area for the period under consideration of 1940-2020, changes in average annual air temperatures (Table 2 and Figure 3) for 81 years, it increased by 2.3840 ˚C with an intensity of 0.029 ˚C/year and annual precipitation increases by 24.400 mm from 0.30 mm/year.

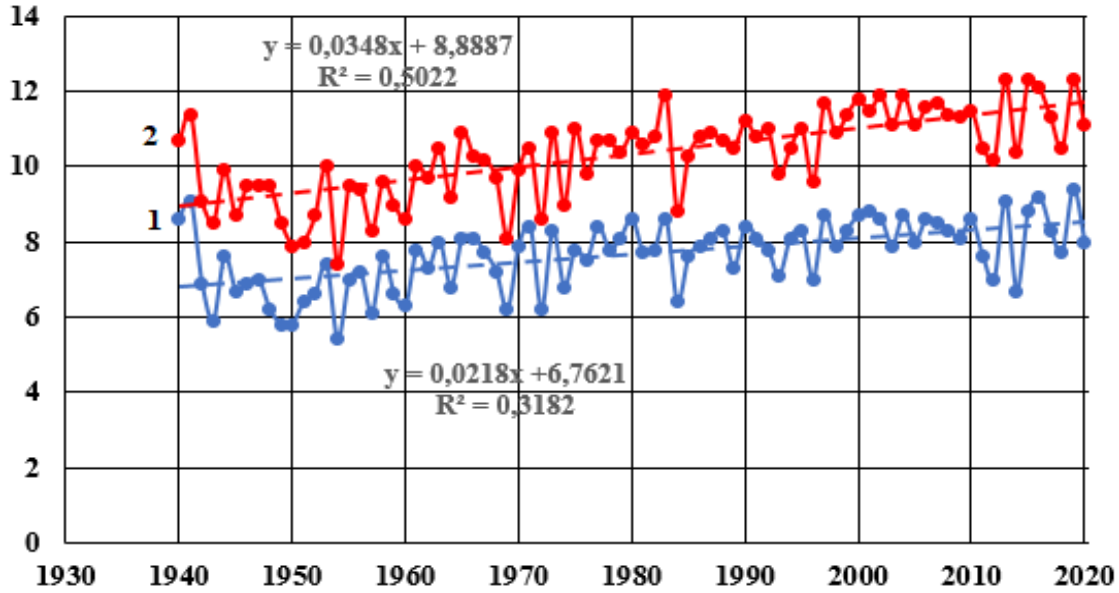

Figure 3 – Graph of changes in average annual air temperatures foothill plain zone of the catchment area of the Assa-Talas river basin (ordinate – average annual air temperature; abscissa – years; 1 -Nurlykent meteorological station; 2- Taraz meteorological station) for 1940-2020 and their linear trend

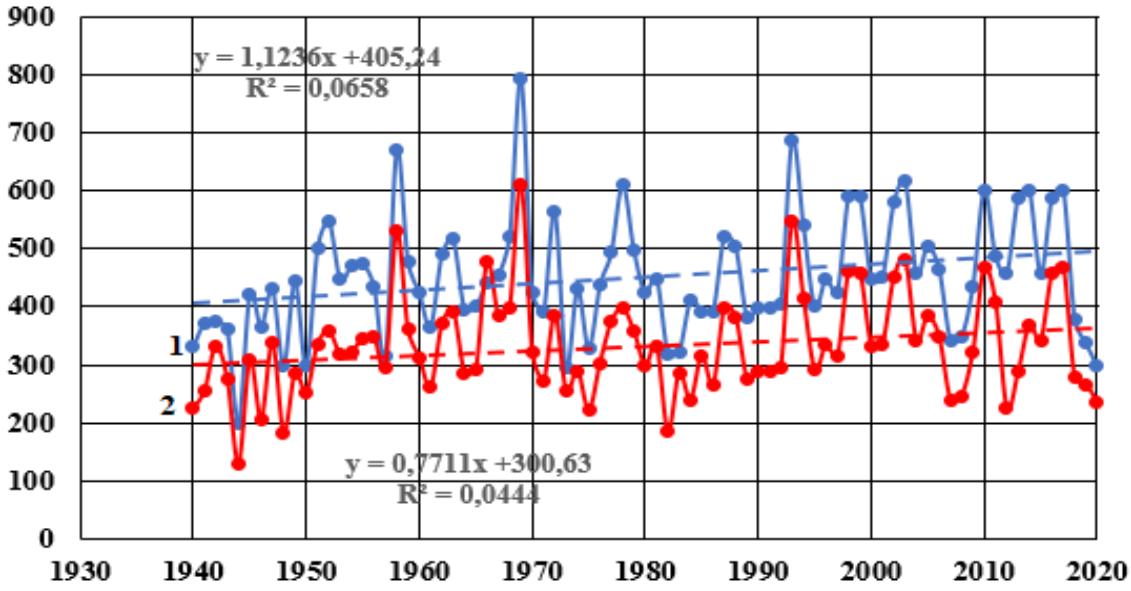

Figure 4 – Annual change chart precipitation foothill plain zone of the catchment area of the Assa-Talas river basin (ordinate – average annual air temperature; abscissa – years; 1 – Nurlykent meteorological station; 2 – Taraz meteorological station) for 1940-2020 and their linear trend

Studies conducted by the meteorological stations Saudakent and Oyik, located in the southern desert of the drainage area of the Asa-Talas river basin, which are a zone of hydrological runoff storage, showed that, despite significant variability over the years, general patterns of change in climate indicators are characteristic, that is, for the period under consideration 1940-2020 (Table 2 and Figure 5-6), respectively, the change in average annual air temperatures for 81 years is 1.880 ˚C with an intensity of 0.023 °C/year and 2.9120 °C with an intensity of 0.036 °C/year, as well as annual precipitation (Table 2) decreases by 30.740 mm from 0.379 mm/year and 72.7360 mm from 0.898 mm / year, respectively.

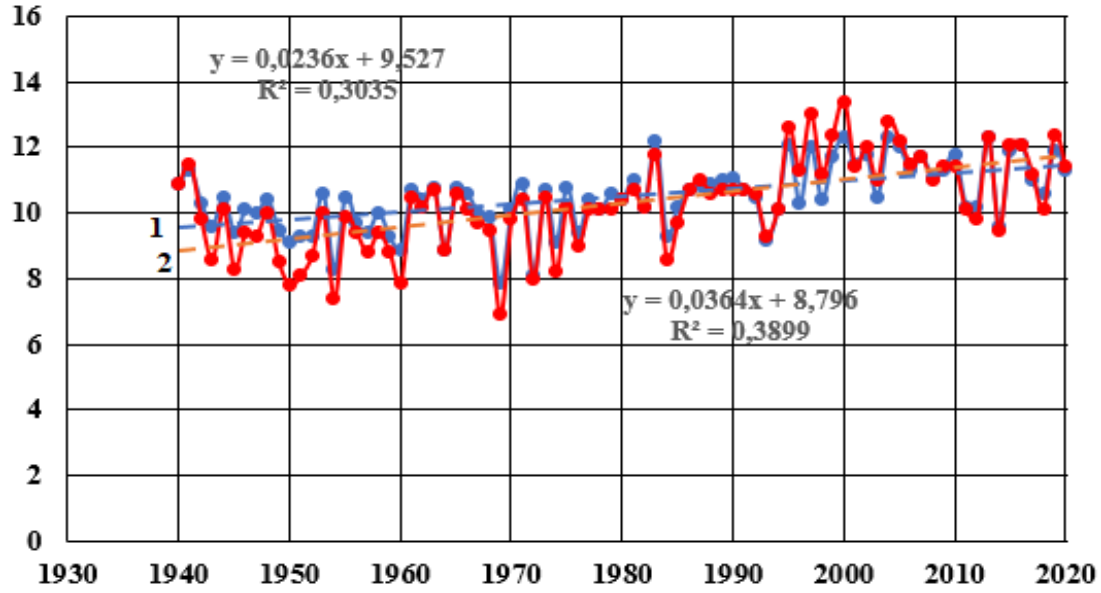

Figure 5 – Graph of changes in the average annual air temperature foothill plain zone of the catchment area of the Assa-Talas river basin (ordinate – average annual air temperature ; abscissa – years; 1 – meteorological station Saudakent; 2 – meteorological station Oyik) for 1940-2020 and their linear trend

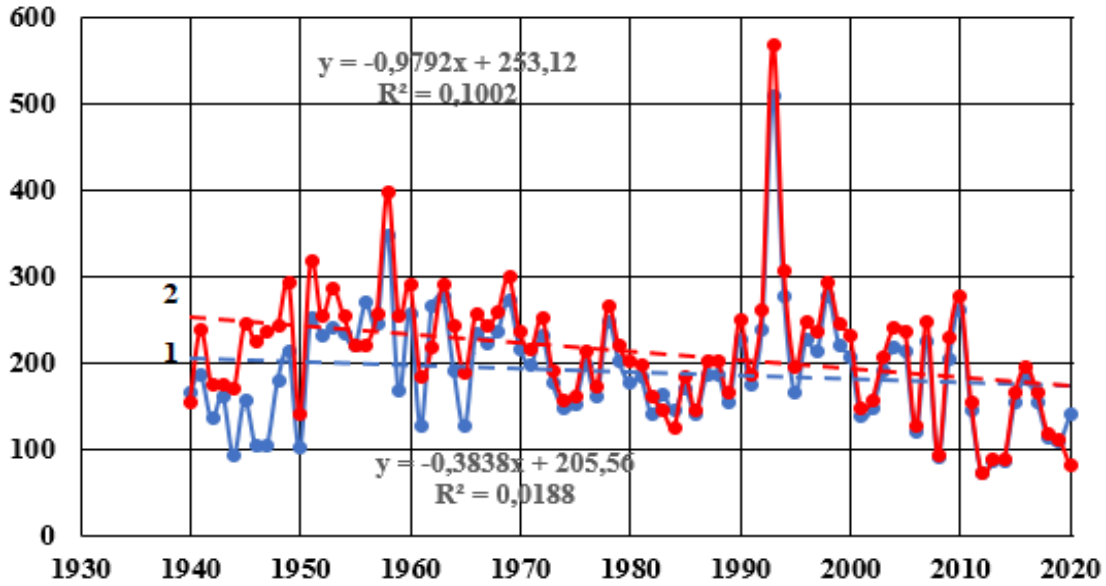

Figure 6 – Annual change chart precipitation foothill plain zone of the catchment area of the Assa-Talas river basin (ordinate – average annual air temperature; abscissa – years; 1 – Saudakent meteorological station; 2 – Oyyk meteorological station) for 1940-2020 and their linear trend

Consequently, the sharply continental, arid nature of the climate in general for the catchment area of the Assa-Talas river basin, which is smoothed out by an increase in precipitation due to the high mountain relief, is determined by its location in the Kyrgyz and Talas the ridge akh, as well as the close location of natural and artificial reservoirs and an increase in air temperatures, are associated with the close proximity of deserts and Moyinkum.

Climate change is a large-scale manifestation of natural processes that go beyond the historical balanced state of nature, inherent in individual natural and geographical zones, which depend on the growth rate of climatic indicators.

Table 2 – Regression models of climate change in the context of natural and climatic zones in the catchment area of the Assa-Talas river basin

weather station	Indicators	Linear trend equation	Change indicators	Growth rate
Susamyr	t_i, °C	$t_i = 0{,}0327 \cdot n_i - 2{,}8405$	2.6180	136.80
	O_{ci}, mm	$O_{ci} = -0{,}453 \cdot n_i + 380{,}81$	-36.2640	-27.98
Talas	t_i, °C	$t_i = 0{,}0298 \cdot n_i + 7{,}0302$	2.3840	24.35
	O_{ci}, mm	$O_{ci} = 0{,}2550 \cdot n_i + 306{,}07$	24.4000	6.24
Nurlykent	t_i, °C	$t_i = 0{,}0218 \cdot n_i + 6{,}7621$	1.7440	20.45
	O_{ci}, mm	$O_{ci} = 1{,}1236 \cdot n_i + 405{,}24$	89.8880	18.11
Kyzyl-Adyr	t_i, °C	$t_i = 0{,}0298 \cdot n_i + 7{,}0302$	2.3840	24.35
	O_{ci}, mm	$O_{ci} = 0{,}4437 \cdot n_i + 260{,}90$	35.4960	11.96
Taraz	t_i, °C	$t_i = 0{,}0348 \cdot n_i + 8{,}8887$	2.7840	23.78
	O_{ci}, mm	$O_{ci} = 0{,}7711 \cdot n_i + 300{,}63$	61.6880	16.99
Saudakent	t_i, °C	$t_i = 0{,}0236 \cdot n_i + 9{,}5270$	1.8880	16.50
	O_{ci}, mm	$O_{ci} = -0{,}384 \cdot n_i + 205{,}56$	-30.704	-17.60
Oyik	t_i, °C	$t_i = 0{,}0364 \cdot T_i + 8{,}7960$	2.9120	24.70
	O_{ci}, mm	$O_{ci} = -0{,}909 \cdot n_i + 253{,}12$	-72.7360	-40.59

The assessment of the growth rate of climatic indicators is carried out on the basis of the equation of linear trends of the time series, characterizing the average annual air temperatures and annual precipitation, allowing to determine their current and base values within the considered time series (Table 2). At the same time, the growth rate of climate indicators is determined as the ratio of the difference between the current and base values of climate indicators to the current value of the time series expressed as a percentage according to the following formulas:

$$\Delta T_t = [(t_m - t_v) / t_v] \cdot 100; \quad (2)$$

$$\Delta T_{Oc} = [(O_{cm} - O_{cv}) / O_{cv}] \cdot 100, \quad (3)$$

where ΔT_t – growth rate of mean annual air temperatures; ΔT_{Oc} – growth rate of mean annual air temperatures; t_m – current values of average annual air temperatures; O_{cm} – current value of annual precipitation; t_v – base value of average annual air temperatures; O_{cv} – base value of annual precipitation.

The evaporative capacity of the day surface (soil and vegetation cover) of the natural system depends on energy resources (temperature and air humidity deficit, radiation balance), that is, it can be represented as a mathematical function having the following form: E_o=f(t,d,R). Based on the physical nature of the evaporative capacity of the day surface (soil and vegetation cover) of the natural system, their growth rate can be represented as follows:

$$\Delta T_t = \Delta T_{Eo};$$
$$[(t_m - t_v) / t_v] \cdot 100 = [(E_{om} - E_{ov}) / E_{ov}] \cdot 100, \quad (4)$$

where ΔT_{Eo} is the growth rate of day surface evaporation; E_{om} – current values of day surface evaporation; E_{ov} – the base value of the evaporation of the day surface.

Based on the theory of water balance in the catchment area of river basins, proposed by A.I.Voeikov (Voeikov A.I., 2021), which includes a three-term equation (layers of atmospheric precipitation, river runoff, total evaporation) characterizing formation of the average annual runoff layer in the watersheds of river basins, depending on the layer of atmospheric precipitation for the year, together with the genetic theory of runoff, according to A.N. Befani (Befani A.N., 1957), can be presented in the following form: $V_c = O_c - E_o$, where V_c is the evaporation layer, mm; O_c – atmospheric precipitation layer, mm.

In this case, the water balance of the catchment area of river basins can be represented by an equation of straight lines with a correlation regression coefficient less than one in the form $Y = k \cdot X + b$ (where k is the regression coefficient; b is the free term of the equation) or $V_c = k \cdot O_c - E_o$, which allows, on the basis of the growth rate of annual precipitation (ΔT_{Oc}), to determine the growth rate of the surface runoff of the river catchment (ΔT_{Qc}), which has a functional straight-line relationship between them in the form $\Delta T_{Qc} = f(\Delta T_{Oc})$

$$\Delta T_{Qc} = \Delta T_{Oc};$$
$$[(O_{cm} - O_{cv})/O_{cv}] \cdot 100 = [(O_{cm} - O_{cv})/O_{cv}] \cdot 100, \quad (5)$$

Where ΔT_{Qc} – growth rate of surface runoff in the catchment area of river basins; O_{cm} – the current value of the surface runoff of the catchment area of the river basins; Q_{cv} – the base value of the surface runoff of the catchment area of the river basins.

At the same time, the system equation of linear trends not only characterizes the mathematical meaning of long-term natural processes, but also is an indicator of the physical processes of the catchment of river basins, characterizing the growth rate of climatic and hydrological indicators.

The resulting systems of equation of linear trends in the study of climate change in the spatio-temporal scale of the catchment area of the Assa-Talas river basin, using long-term information and analytical materials of meteorological stations Susamyr, Talas, Kyzyl-Adyr, Nurlykent, Taraz, Saudakent and Oyik, differing in climatic conditions, allow us to state that the mathematical model of the growth rate of climatic and hydrological indicators proposed on the basis of them has a fairly high physical and mathematical meaning based on the law of nature.

An analysis of the growth rate of climatic indicators in the catchment area of the Assa-Talas River basin shows that their quantitative values for all meteorological stations do not coincide, that is, in modern conditions, the growth rate of average annual air temperatures is twice as high as compared to the growth rate of annual precipitation (Table 2), which contributes to an increase in the water consumption deficit of natural and cultivated agricultural land up to 25% and a decrease in surface hydrological runoff to 15% compared to the middle of the twentieth century, ensuring water security region.

Conclusions

The study of changes in climatic indicators in the catchment area of the Assa-Talas river basin showed that at the meteorological stations Susamyr, Talas, Kyzyl-Adyr, Nurlykent, Taraz, Saudakent and Oyik, the identified trends in average annual air temperatures and annual precipitation differ both in sign and magnitude. Based on them, it can be stated that the growth rate of average annual air temperatures compared to the growth rate of annual precipitation is twice as high, which contributes to an increase in the evaporative capacity of the soil and vegetation covers of the natural system, that is, the water consumption of agricultural land can become the main factor determining the conditions for the formation of river runoff, ensuring water and food security of the region.

References

Barry, R.G. (2001). Mountain climate change andcryospheric responses: A review. Paper presentedat the World Mountain Symposium, Batima, 1-7.

Batima, P., Natsagdorj, L., Gombluudev, P., Erdenetsetseg, B. (2005). Observed climate change in Mongolia. Assess Imp Adapt Clim Change Work Pap, 12, 1-26.

Bhutiyani, M.R., Kale, V.S., Pawar, N.J. (2010). Climate change and the precipitation variations in the northwestern Himalaya: 1866-2006. International journal of climatology, 30(4), 535-548.

Befani, A.N. (1957). Sposoby geneticheskoj determinacii skorosti stoka [Ways of genetic determination of the runoff rate]. OSU Scientific Yearbook. Odessa, 17-23. (in Russian)

Dash, S.K., Jenamani, R.K., Kalsi, S.R., Panda, S.K. (2007). Some evidence of climate change in twentieth-century India. Climatic change, 85(3), 299-321.

Hanski, I. (2005). Landscape fragmentation, biodiversity loss and the societal response: The longterm consequences of our use of natural resources may be surprising and unpleasant. EMBO reports, 6(5), 388-392.

Holten, J.I. (1993). Potential effects of climatic change on distribution of plant species, with emphasis on Norway. Impacts of climatic change on natural ecosystems, with emphasis on boreal and arctic/alpine areas, 84-104.

Kadioğlu, M. (1997). Trends in surface air temperature data over Turkey. International Journal of Climatology: A Journal of the Royal Meteorological Society, 17(5), 511-520.

Karl, T.R., Trenberth, K.E. (2003). Modern global climate change. Science, 302(5651), 1719-1723.

Kawahara, M.,Yamazaki N. (1999). Long-term trend of incidences of extreme high or low temperatures in Japan. Paper presented at the Extended Abstract, Bi-annual meeting of the Meteorological Society of Japan (in Japanese).

Kaser, G., Hardy, D.R., Mölg, T., Bradley, R.S., Hyera, T.M. (2004). Modern glacier retreat on Kilimanjaro as evidence of climate change: observations and facts. International Journal of Climatology: A Journal of the Royal Meteorological Society, 24(3), 329-339.

Markham, A. (1996). Potential impacts of climate change on ecosystems: a review of implications for policymakers and conservation biologists. Climate Research, 6(2), 179-191.

Muhammed, A., Stewart, B.A., Mitra, A.P., Shrestha, K.L., Ahmed, A.U., Chowdhury, A.M. (2004). Water resources in south Asia: An assessment of climate change-associated vulnerabilities and coping mechanisms. Asia-Pacific Network for Global Change Research. Retrieved May, 18, 2009.

Mustafayev, Zh.S., Tursynbayev, N.A., Kireycheva, L.V. (2022).Obosnovanie jekosistemnyh uslug pri obustrojstve rechnyh bassejnov [Justification of ecological services of river basins on the example of the Talas River]. LAP LAMBERN Academic Publishing, 140 p. (in Russian)

Mokhov, I.I. (2019). Contemporary climate changes: anomalies and trends. In IOP Conference Series: Earth and Environmental Science (Vol. 231, No. 1, p. 012037). IOP Publishing. doi:10.1088/1755-1315/231/1/0120

Khalid, S., Azad, S., Rahman, Z. (2017). Climate change: a review of the current trends and major environmental effects. Science Technology and Development, 36(3), 160-176. doi: 10.3923/std.2017.160.176.

Shrestha, A.B., Aryal, R. (2011). Climate change in Nepal and its impact on Himalayan glaciers. Regional environmental change, 11, 65-77.

Scientific and applied reference book on the climate of the USSR. Series 13: Long-term data. Part 1-6, issue 18: KazSSR. – L.: Gidrometeoizdat, 1989. – Book. 2. – 514 p. (in Russian)

Scientific and applied reference book on the climate of the USSR. Series 13: Long-term data. Ch.1-6, issue 32: Kirghiz SSR. – L.: Gidrometeoizdat, 1989. – 450 p. (in Russian)

Voeikov, A.I. (2021). Klimaty zemnogo shara [Climates of the world]. Moscow, 686 p.(in Russian)

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THE IMPACT OF METEOROLOGICAL AND CLIMATIC CONDITIONS ON THE POTENTIAL FOR SELF-PURIFICATION OF ATMOSPHERE ON THE INDUSTRIAL REGION

The article discusses spatiotemporal changes in the main climatic indicators in the period 1941-2020, their impact on the possibilities of the atmospheric self-purification of a lead-zinc mine. The study of changes in air temperature showed the presence of long-term trends, and the climatic potential parameters of the dissipative capacity of the mine atmosphere were calculated. It was found that the average monthly air temperature increases with the rate of warming of 0.19 to 0.34 °C every 10 years. Moreover, a relatively greater increase in temperature occurs in winter, and a smaller increase in summer. Determined that the anomalous air temperature field is large in the study area both in winter and summer months. Based on the calculations, data on the spatiotemporal variability of the climatic potential of the dissipation capacity and the coefficient of atmospheric self-purification were obtained. This made it possible to establish that throughout the entire annual cycle, unfavorable conditions are observed for the dispersion of polluting particles in the atmospheric air, and to a greater extent during the cold period of the year. The results indicate the manifestations of natural and anthropogenic atmospheric processes that prevent the dispersion of pollution in the atmosphere. The performed research is significant for the practical use. Since data on the spatial and temporal variability of the dispersion potential of atmospheric air must be previously assessed when implementing measures to manage air quality in an industrial region.

Key words: atmospheric pollution, climate change, climatic potential of atmospheric dispersal ability, coefficient of the atmosphere's self-purification, aridization, lead-zinc mine.

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Өнеркәсіптік аймақ атмосферасының өзін-өзі тазалау әлеуетіне метеорологиялық-климаттық жағдайлардың әсерін талдау

Негізгі климаттық көрсеткіштердің кеңістіктік-уақыттық өзгерістері және олардың 1941-2020жж. кезеңіндегі қорғасын-мырыш кеніші ауданындағы атмосфераның өзін-өзі тазарту әлеуетіне әсері мақалада қаралады. Ауа температурасының зерттеу ұзақ мерзімді тенденциялардың болуын көрсетті.Ауаның орташа айлық температурасы әр 10 жыл сайын 0,19-дан 0,34 °С-қа дейін жылыну жылдамдығымен көтерілетіні анықталды. Сонымен қатар, температураның ең үлкен өсуі қыста, ал ең азы жазда болады. Аномальды ауа температурасы өрісі зерттелетін аумақта қыста да, жазда да үлкен болатыны көрсетілген.Атмосфераның шашырату қабілеттілігінің климаттық әлеуетінің және өзін-өзі тазарту коэффициентінің кеңістіктік-уақыттық өзгермелілігінің деректері алынған. Бүкіл жылдық цикл бойы атмосфералық ауада ластаушы бөлшектердің дисперсиясы үшін қолайсыз жағдайлардың және көбінесе суық мезгілдерде болатыны анықталды. Алынған нәтижелер атмосфераның ластануының таралуы болдырмайтын табиғи және антропогендік атмосфералық процестердің көріністерін көрсетеді. Жүргізілген зерттеулер практикалық қолдану үшін маңызды. Себебі атмосфералық ауаның шашрау әлеуетінің кеңістіктік және уақыттық өзгермелілігі туралы мәліметтерді өнеркәсіптік аймақта ауаның сапасын басқару шараларын жүзеге асыру кезінде алдын ала бағалау қажет.

Түйін сөздер: атмосфераның ластануы, климаттың өзгеруі, атмосфераның шашырату қабілетінің климаттық әлеуеті, атмосфераның өзін-өзі тазарту коэффициенті, аридизаттау, қорғасын-мырыш кеніші.

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Влияние метеорологических и климатических условий на потенциал самоочищения атмосферы промышленного региона

В статье рассматриваются пространственно-временные изменения основных климатических показателей в период 1941-2020гг, их влияние на потенциал самоочищения атмосферы в районе свинцово-цинкового рудника. Изучение изменения температуры воздуха показало наличие долгопериодных тенденций. Установлено, что среднемесячная температура воздуха увеличивается со скоростью потепления от 0,19 до 0,34 °С каждые 10 лет. Причем, наибольшее повышение температуры приходится на зимний период, а наименьшее на лето. Показано, что аномальность поля температуры воздуха велика в районе исследования как в зимние, так и летние месяцы. На основании расчетов получены данные пространственно-временной изменчивости климатического потенциала рассеивающей способности и коэффициента самоочищения атмосферы. Установлено, что в течение всего годового хода отмечаются неблагоприятные условия для рассеивания загрязняющих частиц в атмосферном воздухе, при этом в большей степени в холодный период года. Полученные результаты свидетельствуют о проявлениях природных и антропогенных атмосферных процессов, препятствующих рассеиванию загрязнений атмосфере. Выполненные исследования имеют важное значение для практического использования. Поскольку данные о пространственной и временной изменчивости рассеивающего потенциала атмосферного воздуха необходимо предварительно оценивать при реализации мероприятий по управлению качеством воздуха промышленного региона.

Ключевые слова: загрязнение атмосферы, изменение климата, климатический потенциал рассеивающей способности атмосферы, коэффициент самоочищения атмосферы, аридизация, свинцово-цинковый рудник.

Introduction

The atmosphere is characterized by unlimited capacity, high mobility, variability constituent components, the uniqueness of physical, chemical processes and transformations. The specific features of these transformations are associated with both natural and anthropogenic factors (Morozov A.E., Starodubzeva N., 2020:123). The intra-annual atmosphere course and the underlying surface thermal state is the most important elements in all Earth's atmosphere models of the general circulation, which determines climate change (Perevedentsev Yu.P., Khabutdinov Yu.G., 2012:23). Climate, as a dynamic form, has constantly changed in the historical past, is changing now and is predicted to change in the future (NRC, 2020). Over the past few decades research on climate change (Kogan F, Guo W, 2014:127 ; Alexander L, 2016:4) has shown that the Central Asia region has warmed faster than other regions (Santer B et al., 2018:6399). Among these mechanisms, solar activity is the main natural factor driving the climate change.

Nowadays, climate change is accelerating the depletion of natural resources, as production and consumption amid ongoing pollution require more energy and materials. The anthropogenic factor is responsible for the greenhouse effect which linked to an increase in the concentration of carbon dioxide and other small gas components in the atmosphere (Belousova E.P., et al, 2023:73). According to the UN, air pollution is recognized as the most important environmental contributor to the global burden of diseases, causing millions of premature deaths and large economic losses every year (Asrar G.R. et al, 2019). This work aimed at studying of spatiotemporal changes in the main climatic indicators in the period 1941-2020, their impact on the potential for atmospheric self-purification in the area of the lead-zinc mine.

The aim of the study is to analyze the impact of meteorological and climatic conditions on air pollution levels, and the spatiotemporal variability of lead-zinc mine's surface atmosphere self-purification (using the Shalkiya mine as example).

Research methods

Study Area

The state of atmospheric air in the mining area is determined by a combination of natural and anthropogenic impacts. JSC "ShalkiyaZinc LTD" is an enterprise for the extraction and processing of Pb/Zn ore at the Shalkiya deposit, which is located in the southeast of Kyzylorda, in the northeast, 17 km from the city of Zhanakorgan, at

67°25’00»E east longitude and 44°01’20»N latitude (Figure 1).

According to the research company BrookHunt (2006), the total Zn reserves of the Shalkiya deposit account for more than 30% of Kazakhstan’s total reserves and are the 5th largest deposit in the world with proven and probable reserves about 6.5 million tons of Zn. (Salnikov V. et al, 2024:71). The Pb content ranges from 0.9 to 1.67%, Zn- from 3.8 to 4.36%, averaging 1.30 and 4.28%, respectively. The host rocks of the deposit are classified as low- and medium-abrasive. The average content of silica in the ores and rocks of the deposit is 41-50%. JSC “ShalkiyaZinc LTD” plans to build an enrichment plant with a capacity of 4 million tons per year. Now at the main industrial site of the mine at the border of the sanitary protection zone and in settlements, the atmospheric pollutants concentrations from stationary sources do not exceed the established limits, comply with applicable standards, except for the increased dust content (Salnikov V. et al, 2024:71). But dust particles may contain heavy metals pose hazard during the operation of the concentrator, both in the working area and in the open tailings. Due to exposure to oxidizing agents and weather conditions, they are potentially hazardous (Whaley P., et al, 2021; Golokhvast K.S., et al, 2012:5; Punia A. 2021:4056).

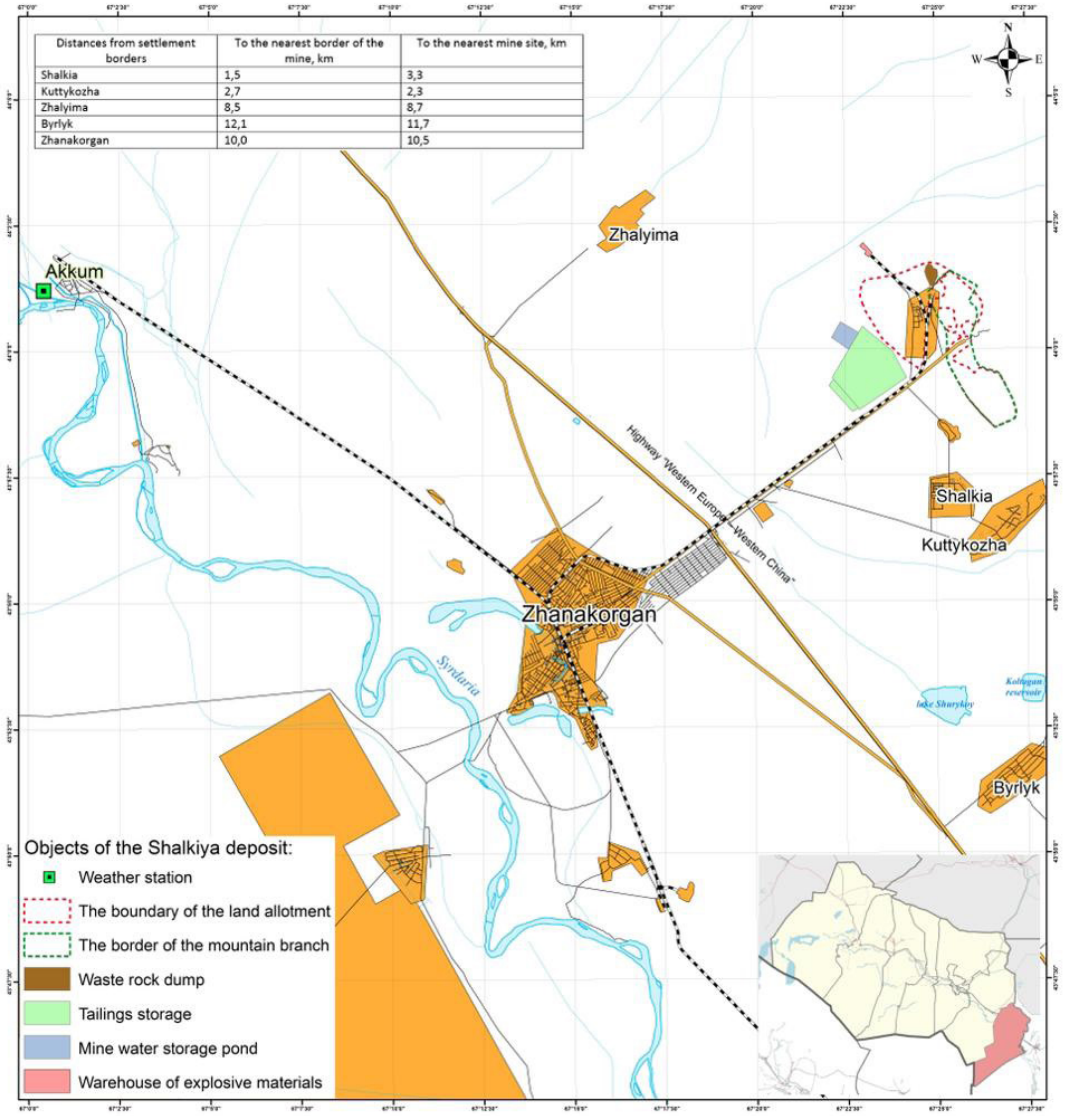

Figure 1 – Map showing the location of the Shalkiya mine in South Kazakhstan, as well as adjacent settlements and other objects. Source: Compiled by the authors based on https://www.ebrd.com

The objectives of the study on the Shalkiya mine are:

- meteorological and climatic conditions;
- the potential of self-purification;
- the spatiotemporal variability of lead-zinc mine's surface atmosphere.

Information database

When assessing the potential for atmospheric pollution, it is advisable to use, instead of individual meteorological elements, complex parameters that characterize a specific meteorological situation and conditions (Morozov A.E., Starodubtseva N.I., 2020:123). As the information base for the study of the meteorological characteristics influence and calculations of the potential for atmospheric air dispersion and self-purification there were used data of the average long-term meteorological parameter's values for the meteorological station Akkum (Figure 1). It is located in close proximity to the object of study (hereinafter for brevity Akkum). These data taken from the reference books on Kazakhstan's climate (Spravochik po klimatu Kazakhstana, 2003:04, 05,16), which will allow us to determine the meteorological and climatic potential of atmospheric pollution (MPAP, CPAP) in the study area. According to the methodology (Selegey T.S., et al, 2015:725), MPAP, (CPAP) calculated by the formula:

$$CPAP = \frac{(R_c + R_f)}{(R_p + R_w)} \quad (1)$$

where: R_c – repeatability of weak wind speeds 0-1 m/s;

R_f is the repeatability of the number of days with fog;

R_p is the repeatability of the number of days with precipitation ≥ 0.5 mm;

R_w – repeatability of wind speeds ≥ 6 m/s. (Kabdykadyrov A.A., et al, 2021:308)

This indicator is characterized in such a way that the larger the MPAP(CPAP) index, the worse the conditions for the dispersion of impurities (Table 1).

Table 1 – Criteria for dispersion conditions in terms of CPAP (Selegey T.S. et al., 2015:725)

Gradation number	CPAP value	Characteristics of dispersion conditions
1	<0.8	Favorable
2	0.8-1.2	Intermediate (buffer zone)
3	1.2-2.4	Adverse
4	>2.4	Extremely unfavorable

Atmosphere self-purification coefficient K, inverse CPAP, taking into account the conditions of dispersion (Lapina S.N. et al., 2008:8; Stambekov M.D., Turulina G.K., 2016:7)

$$K = \frac{1}{CPAP} \quad (2)$$

The coefficient of the atmosphere self-purification (K) is calculated as the ratio of the repeatability of processes that positively affect the removal of impurities from the atmosphere, to the repeatability of processes that contribute to the accumulation of air pollutants (Krymskaya O.V, et al, 2016:124).

The study of large anomalies of air temperature fields in this work was carried out according to the Bagrov criterion (Bagrov N.A., Myakisheva N.N., 1966:53). Bagrov's anomaly index (K_b) is calculated using the formula:

$$K_b = \frac{1}{N}\sum_{i=1}^{N}\left(\frac{\Delta T_i}{\sigma}\right)^2 \quad (3)$$

where:

ΔT_i – anomaly of average monthly air temperature at a point at the i-th station

σ – standard deviation of temperature;

N – number of stations.

Threshold values for the K_B index: when $K_B \geq 1.15$ the field anomaly is large, when $K_B \leq 0.75$ there is a slight anomaly and when $0.75 < K_B < 1.15$ the anomaly has medium intensity (Bagrov N.A., Myakisheva N.N., 1966:53; Stambekov M.D., Turulina G.K., 2016:7).

Literature review

In the modern world, lead and zinc are widely used in the construction and automotive industries

of the world. However, the global assessment of Pb-Zn mineral resources clearly reflects the environmental challenges facing the lead-zinc (Pb-Zn) ores mining sector. A great risk to the environment, especially atmospheric air, is the huge amount of uncontrolled waste (tailings) of Pb/Zn mines located in tailings (Mohr S. at.al, 2018:17; Tao Chen, et.al, 2022:120328). Sustainable environmental management is becoming important due to both natural causes of climate change on Earth, and increased impact of anthropogenic factors (Gazaryan V.A., et al, 2022:1). At least 226.1 million tons Pb and 610.3 million tons Zn are shown to be present in 851 individual mineral deposits and waste treatment projects in 67 countries at an average grade of 0.44% Pb and 1.20% Zn, (Mudd G.M. et al., 2017:1160). Moreover, only China produces most of the used Pb, Zn in the world. At the same time, a large amount of waste (tailings) of Pb/Zn mines is placed in tailings without proper management, which poses a significant risk to the local ecosystem and residents of mining areas around the world (Mohr S, et al, 2018:17). Tailings are known to be potentially hazardous due to exposure to oxidants and weather conditions. Thus, according to the mining industry operating data, the amount of tailings generated is estimated at about 0.26-2.5 tons for each ton of Pb/Zn ore processed. It is estimated that there are more than 8100 tailings dumps worldwide with a release volume of 10 billion m^3 (Chen et al, 2022: 120328). Containing Pb, Zn, Cd, and other heavy metals suspended particles can pose a hazard during the operation of the concentrator, both in the working area and in the open tailings, as they are potentially hazardous due to exposure to oxidizing agents and weather conditions (Whaley P. et al., 2021; Golokhvast K.S. et al., 2012:5).

Atmospheric synoptic weather parameters play a significant role in determining the transportation, dispersion, and concentration of air pollutants in different geographical areas (Demuzere M., et al, 2009:2695). Meteorological elements are a general name for a number of characteristics of the atmospheric air state and some atmospheric processes. These include characteristics of the atmosphere state and atmospheric processes that are directly observed at meteorological stations: atmospheric pressure, air temperature and humidity, wind (horizontal air movement), cloudiness (in terms of quantity and form), amount and type of precipitation, visibility, fogs, blizzards, etc. (Morozov A.E., Starodubtseva N.I., 2020:123).

Meteorological conditions influence the processes of accumulation and dispersion of the atmospheric impurities (Assanov D., et al, 2021:200663). The atmospheric dispersion is the main process that governs the transfer of a pollutant within the atmosphere. The dispersion of a pollutant is strictly related to the atmospheric condition in which it is diluted. The atmospheric turbulence is a complex phenomenon to study and to analyze (Adami L., Boffadossi M., 2020). The authors (Lai et al., 2023:406) assessed the influence of atmospheric synoptic weather conditions and the transfer of air masses over long distances. The long-term weather shifts have been observed to positively impact reducing the concentration of PM_{10} extreme events.

The studies (Selegey T.S. et al., 2015:725) of the meteorological potential of atmospheric pollution for 196 weather stations of Western Siberia from 1986 to 2010, analyzing the meteorological potential of pollution from 1986 to 2010. revealed a change in meteorological conditions for dispersing impurities in the surface layer of the atmosphere almost throughout the region for the worse due to an increase in the repeatability of weak winds 0 – 1 m/s, with a simultaneous decrease in the repeatability of winds ≥ 6 m/s.

There is an extensive literature devoted to the study of the climatic factors role and the assessment of the atmospheric air surface layer state in the mining industry (Prabhakar G., et al., 2014:339; Punia A., 2021:4056; Kozhagulov S.O., Salnikov V.G., 2023). The study (Prabhakar G. et al., 2014:339) a spatial and temporal trends in the concentration of airborne solid particles of metals and metalloids in southern Arizona, characterized by a high density of active and abandoned mines, it was found that periods with a high concentration of fine soil coincide with a higher concentrations of metals in the atmosphere, with higher increases in urban areas. The arid climate favors dust emissions from natural and human activities.

The review (Punia A., 2021:4056) also shows that climatic factors such as temperature, precipitation and wind significantly affect the distribution of pollutants in arid, semi-arid regions; wind, water and pollute the environment. In study (Wang H., 2022:119529), precipitation was identified as the most important driving force for the migration of heavy metals in Pb-Zn tailings, which are hazardous wastes generated after ore crushing, magnetic separation, differ-

ential flotation and Pb-Zn recovery from production Pb -Zn concentrates.

Kazakhstan's atmospheric air, in general, has an uneven predisposition to pollution according to climatic conditions. The physical-geographical and climatic features of Kazakhstan include, firstly, the fact that lightly dispersed soils prevail on its territory (Ershibulov A.K., 2016:125). If there is dry and hot weather most of the year in desert, semi-desert and steppe areas poor in vegetation, these soils create favorable conditions for the formation of increased background of natural dust pollution atmosphere. In addition, high intensity solar radiation contributes to the formation of secondary harmful substances (with presence of pollutants).

They may be more toxic than the original products. This is due to photochemical reactions associated with formation of photochemical smog (Salnikov V.G., 2006:230). In addition, due to natural and climatic conditions, the territory is characterized by a significant predominance of evaporation over precipitation, which has formed highly saline lands. Similar loose and overdried soil low organic matter layers are easily exposed to wind (Geldiyeva G.V. et al., 2004:236; Omuto C.T. et al., 2023:13157). Apparently, dry and hot weather in most of the year due to favorable conditions are created for the formation of an increased natural pollution of the atmosphere background with dust. Thus, the meteorological parameters are one of the important indicators in the study of atmospheric air pollution. In this aspect, the study of spatial and temporal variability of climatic conditions, assessment the potential scattering ability of the atmosphere becomes unprecedentedly relevant.

Results and the discussion

The initial indicators for the temperature regime analysis were the data of the average annual monthly values of air temperature at Akkum. Table 2 shows the data on the average monthly and annual norms of air temperature and the amount of precipitation. The "norm" in the current work refers to the long-term average value of the considered climate variable for the period 19812010 (Kabdykadyrov A.A. et al., 2021:308).

Table 2 – Annual norm and average monthly air temperature (T, °C), the amount of precipitation (R,mm) at Accum for the period 1981-2010

Month	11	22	43	64	85	76	77	88	99	110	111	112	Year
T, °C	-4,6	-1,6	5,8	14,4	20,9	26,8	28,7	26,7	19,8	11,1	3,7	-2,7	12,4
R,mm	21	21	23	21	21	8	7	1	2	9	25	21	180

Source: Compiled by the authors based on Handbook on the climate of Kazakhstan (Spravochik po klimatu Kazakhstana, 2011)

Analysis of Figure 2 shows that in the annual course, the minimum average monthly air temperature falls on January – minus 4.6 °C, and the maximum in July -plus 28.7 °C. The annual amplitude of fluctuations in air temperature is 33.3 °C. The average annual air temperature is positive and amounts to 12.4°C. From January to February, there is a slight increase in the average annual air temperature due to the fact that the radiation and circulation conditions of these months are similar to each other. Further, with an increase in the influx of solar radiation, from February to March, an increase in air temperature is observed. Then, during the complete transition from negative to positive radiation balance (Stambekov M.D., Turulina G.K., 2016:7), the largest increase in temperature in a year is noted. Further, from July to August, a slow decrease in temperature begins. Then, due to the change and restructuring of the circulation, as well as the transition of the radiation balance to a negative value, the largest decrease in air temperature is observed, this strong drop is observed from September to December.

One of the meteorological phenomena that favors the purification of atmospheric air from pollutants is precipitation. When the atmosphere is cleaned, pollutants are washed out and enter the soil, vegetation cover and water.

Average monthly amount and repeatability (%) of the days' number with precipitation $\geq$ 0.5 mm at Akkum is shown in Figure 2 and Table 3. Two maxima (in November and March) can be observed 25 mm and 23 mm respectively. In August, vice versa,

can be noted the minimum precipitation (1 mm). It can be observed that from January to May precipitation varies slightly (from 21 to 23 mm), and there is a significant drop to 7 mm in June, then in August can be noted a minimum dropping. There is a slowly increase (to 9 mm) from September to October, then in November there is a rapid increase in precipitation up to 25 mm, which is the second maximum. Then there is a slight decrease in December. The annual amount of precipitation is 180 mm.

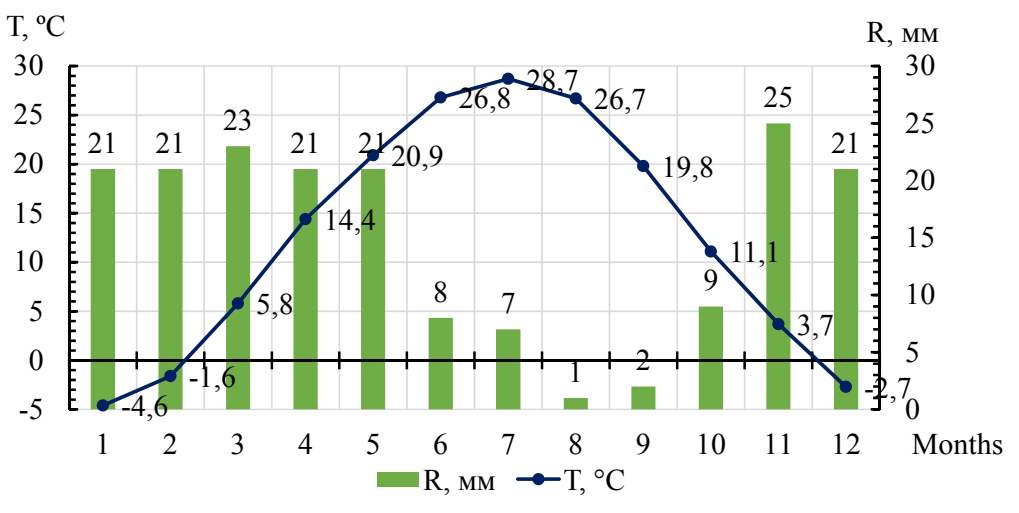

Figure 2 – The annual course of the average monthly air temperature and the amount of precipitation at the Akkum (Source: Compiled by the authors based on (Spravochik po klimatu Kazakhstana, 2003:04, 05,16; ND RK, 2022))

Table 3 – Average monthly amount and repeatability (%) of the days' number with precipitation ≥ 0.5 mm at Akkum

Month												Year
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	
1,5	1,3	2,0	2,1	1,8	0,7	0,6	0,1	0,1	1,0	1,5	1,6	14,3
21	21	23	21	21	8	7	1	2	9	25	21	180

As a rule, to characterize the intensity of change in temperature (or other meteorological element) for a selected period of years, the value of the linear trend slope (rate of change) in the time course of air temperature is used (Perevedentsev Yu. P., et al, 2019:32; ND RK, 2022). Figure 3 (a, b, c, d) shows graphs of the average monthly temperature time course for winter, spring, autumn and summer, respectively, according to the Akkum data for the period 1941-2020, from which you can see that the trend lines everywhere have positive trends. Thus, in winter air temperature rises at a rate of 0.34 ºC every 10 years, in spring – 0.28 ºC / 10 years, in summer – 0.19 ºC / 10 years, in autumn – 0.27 ºC / 10 years.

Thus, in the specified area in the time course for the period 1941-2020 there is an increase in air temperature with a rate of warming from 0.19 to 0.34°C every 10 years. The data obtained are consistent with the changes of Kyzylorda region air temperature from 1961 to 2020. based on the nonparametric statistical method of Mann-Kendall. It was noted that over the selected period, average annual temperature changes increased by 0.02...0.05°C (Abdullah N. et al., 2024:65). Moreover, the greatest increase in temperature is observed in winter, and the least in summer. Positive trends in the trend lines of average monthly temperatures are associated with an increase in greenhouse gas concentrations. Elevated temperatures are accompanied by a loss

of soil moisture and further drying. Current trends promote aridization, which leads to the process of desertification of the territory, as a result of which increased concentrations of suspended particles in the atmospheric air can be observed (Salnikov V. et al, 2024:71).

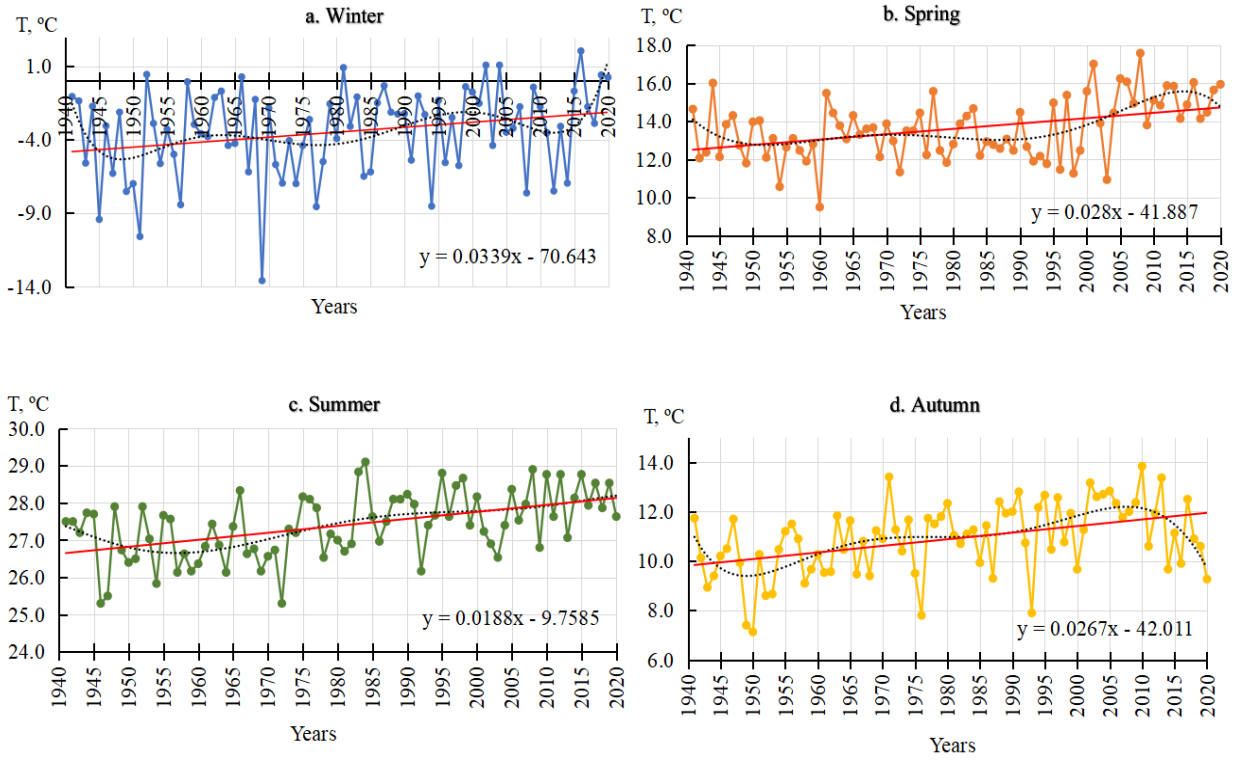

Figure 3 – Average monthly air temperature at MS Akkum for the period 1941-2020

As an indicator of anomaly in climate studies, deviations of meteorological values from average long-term values or their ratio to the average standard deviation are widely used (Gruza G.V., Rankova E.Ya., 2012:194). A comprehensive assessment of the degree of anomaly of the temperature field is the Bagrov anomaly index (K_B), which allow to quantitatively reflect the duration and temporal distribution of air temperature extremes. In this work, the K_B index is calculated for winter and summer (Figure 4 and Figure 5).

Based on the calculated values of the Bagrov index ($K_B \geq 1.15$), a catalog of extremely cold (EC) and warm (EW) months for winter and summer was compiled. According to MS Akkum for the study period 1941-2020. 63 cases with deviations of air temperature from the norm in winter were identified, including 33 cases with EC and 30 EW years, and in the summer 74 cases with anomalies were identified: 36 cases of EC and 38 cases of EW.

The atmospheric air purification from pollutants largely depends on the precipitation's amount and intensity. According to studies, during precipitation, there is a decrease in the concentrations of sulfur dioxide and nitrogen dioxide. After rain in summer tropospheric ozone and other impurities are removed from the atmosphere almost in full (Kabdykadyrov A.A. et al, 2021:308; Korotkova N.V., Semenova N.V., 2014:194).

An important role in leaching pollutants from the atmosphere plays the precipitation duration. It significantly influences in washing pollutants out of the atmosphere. During precipitation with a duration of 6 hours or more, a reduced level of air pollution is formed. Restoration and return of the initial level of air pollution is carried out gradually, within 12 hours. The described dependence refers to concentrations that are formed outside the direct impact of sources, while during the direct transfer of emissions from pollution sources, the effect of remov-

ing atmospheric impurities is manifested to a lesser extent. The influence of liquid and solid precipitation on the purification of the atmosphere is taken into account through the repeatability of the number of days with precipitation more than or equal to 0.5 mm per day. A number of researchers suggest that this amount of precipitation is capable of depositing roadside dust and other impurities in the air (Lapina S.N. et al., 2008:8; Korotkova N.V., Semenova N.V., 2014:194). Table 3 shows the repeatability (%) of the days' number with precipitation ≥ 0.5 mm at Akkum.

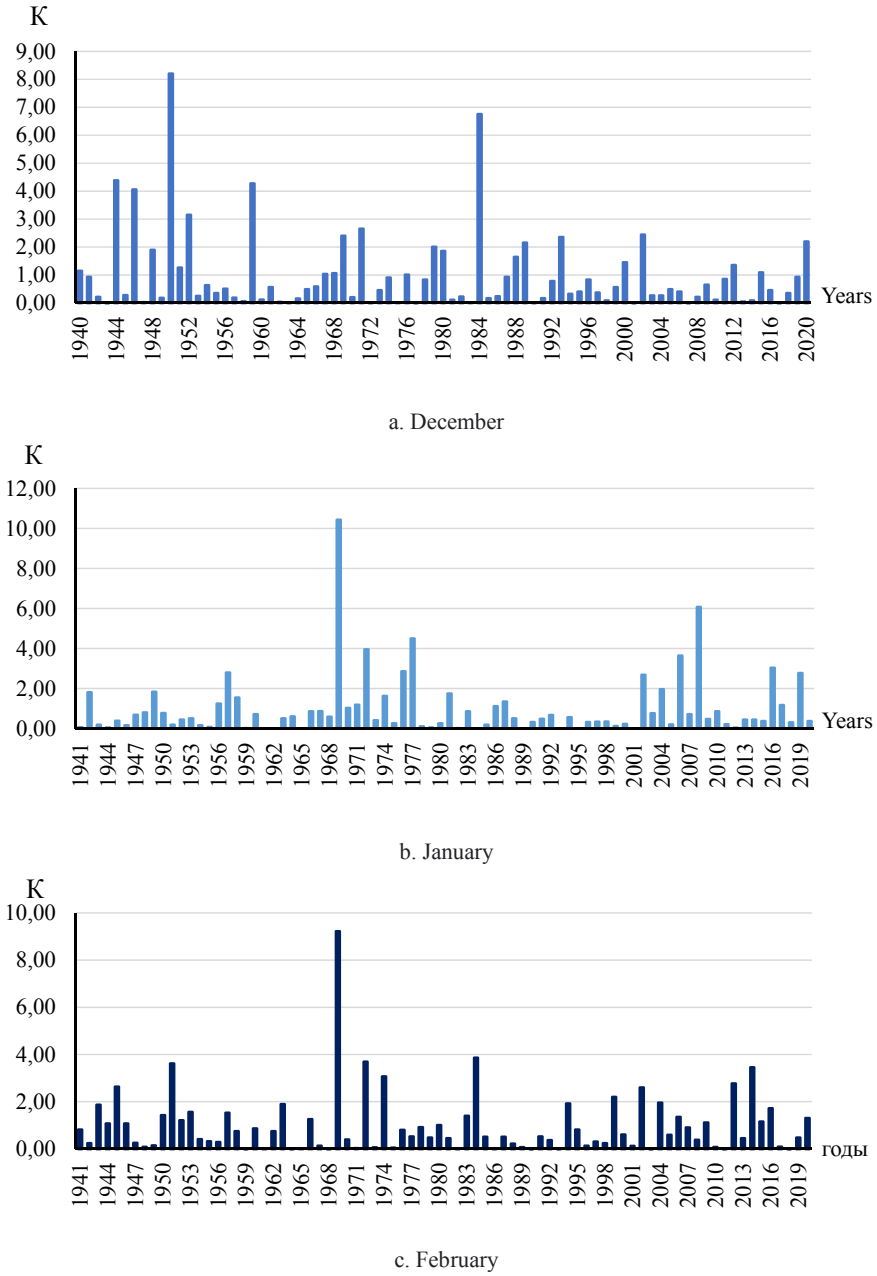

Figure 4 – K_B index values for winter for the period 1941-2020

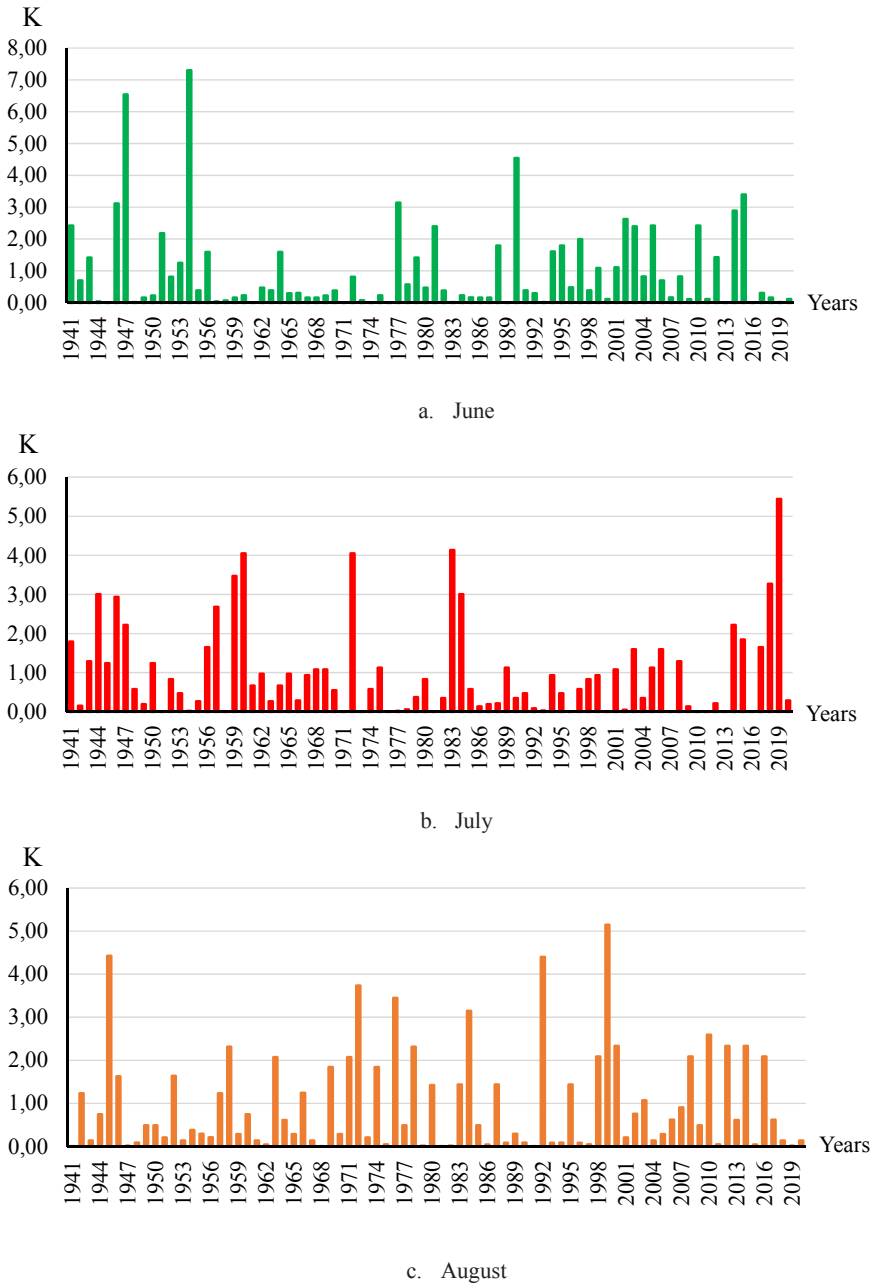

Figure 5 – K_B index values for summer for the period 1941-2020

Analysis (Table 3) shows that in the long-term regime for the meteorological station Akkum, the highest repeatability of precipitation with a gradation of ≥ 0.5 mm is observed in the spring season from March to May within 1.8-2.0%, and the lowest in August and September is 0.1%, while the average annual the repeatability value of this gradation is only 14.3%. Very low precipitation and high evaporative capacity of the day surface determine the intensity and direction of the biological and geological circulation of water and chemicals. Fog formation causes an increase in ground-level concentrations of pollutions, as water droplets tend to absorb harmful chemical concentrates. After that, toxic impurities begin to settle in the surface layers of the atmosphere, which leads to an increase in total concentrations. Due to the accumulation of significant concentrations (outside water droplets), pollutants are transferred from the surrounding space to the area of fog formation. Above the fog zone, a

significant risk is the presence of smoke plumes, under the influence of which pollution spreads into the surface air layer (Lapina S.N. at al, 2008:8). Repeatability data (%) of the days' number with fogs in the area of meteorological station Akkum are presented in Table 4.

Table 4 – Average monthly repeatability of the days' number of with fogs at Akkum

Month												Year
1	2	3	4	5	6	7	8	9	10	11	12	
1,1	0,6	0,4	0,1	0,0	0,0	0,0	0,0	0,0	0,1	0,5	1,3	4,0

The number of days with fogs (Table 4) is small in the study area. The presence of days with fogs is noted in the cold period, where the highest repeatability in December reaches only 1.1%, and the minimum in October and April is 0.1%. In the warm season (from May to August) foggy days are completely absent.

Table 5, according to the climate reference book, shows the average monthly and average annual repeatability (%) of wind directions at Akkum (Spravochik po klimatu Kazakhstana, 2005).

According to Table 5, the average annual frequency of calms on Akkum is 38%, the highest level is observed in the autumn season within 44-50%, and the lowest from January to March -20-22% respectively.

The Figure 6 shows the wind rose, built on the average annual repeatability of wind directions, in accordance of which the most predominant direction is the northeast wind – 30%.

In Table 6, the repeatability (%) of wind directions were calculated for the seasons of the year at Akkum.

Table 5 – Average Akkum's wind directions monthly repeatability (%)

Month	Wind direction								Calm
	N	NE	E	SE	S	SW	W	NW	
1	8	8	12	31	14	5	7	15	22
2	9	8	13	26	12	7	8	17	20
3	11	11	11	16	11	9	11	20	20
4	12	28	24	4	5	8	11	8	32
5	15	26	19	3	4	7	14	12	36
6	18	28	16	3	2	4	10	19	34
7	25	26	11	2	1	3	10	22	34
8	23	36	13	1	1	2	8	16	36
9	18	33	16	2	2	5	10	14	45
10	14	28	15	3	5	10	15	10	50
11	11	29	22	4	6	12	9	7	44
12	8	27	23	5	8	15	10	4	43
Year	15	30	19	3	4	8	10	11	38

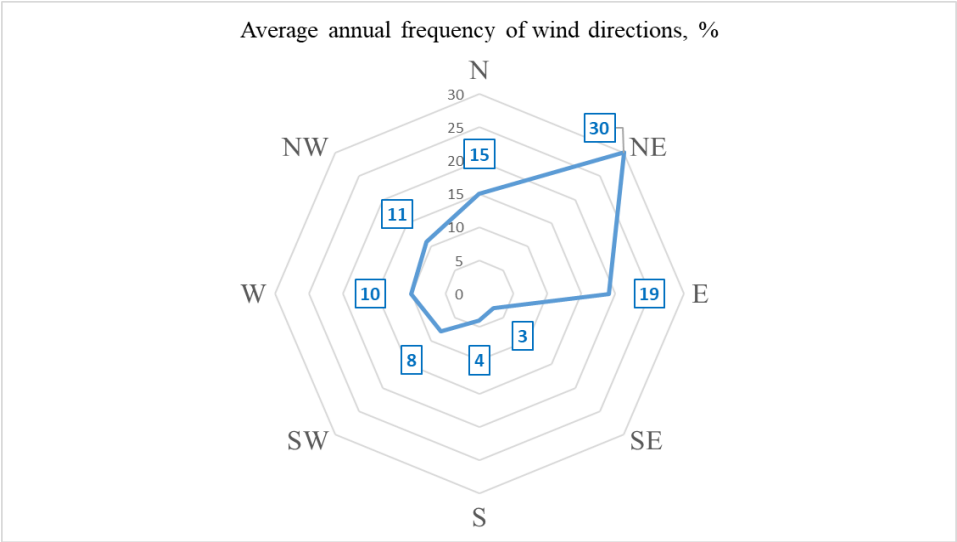

Figure 6 – Wind rose of average annual repeatability (%) of wind directions at Akkum
(Source: Compiled by the authors based on (Spravochik po klimatu Kazakhstana, 2005))

Table 6 – Repeatability (%) of wind directions by seasons at Akkum

Season	Wind direction								Calm
	N	NE	E	SE	S	SW	W	NW	
Winter	20	25	33	59	29	17	18	33	56
Spring	13	22	18	8	7	8	12	13	29
Summer	22	30	13	2	1	3	9	19	35
Autumn	14	30	18	3	4	9	11	10	46
Year	15	30	19	3	4	8	10	11	38

Figure 7 shows a wind rose constructed from the seasonal frequency of wind directions at Akkum.

According to the analysis of Table 6 and Figure 7 in spring, summer and autumn, the northeast wind direction is predominant, with a repeatability of 22-30%, respectively and in winter, southeastern directions prevail – 59%. Thus, the potential emissions of pollutants from the planned production at the Shalkiya field will be mostly transferred to the southwest of the Kyzylorda region. Table 7 shows the average monthly repeatability of occurrence (%) of weak (0-1 m/s) and strong (≥ 6 m/s) winds at Akkum.

According to the climatic data (Table 7), at Akkum, in the warm season observed the wind speeds repeatability with a gradation of ≥ 6 m/s, in particular from April to August, up to 10.7%. The number of days with weak winds repeatability (with a gradation of 0-1 m/s) occurs on the cold period of the year, from September to March, ranging from 45.4% (in March) to 58.5% (in November).

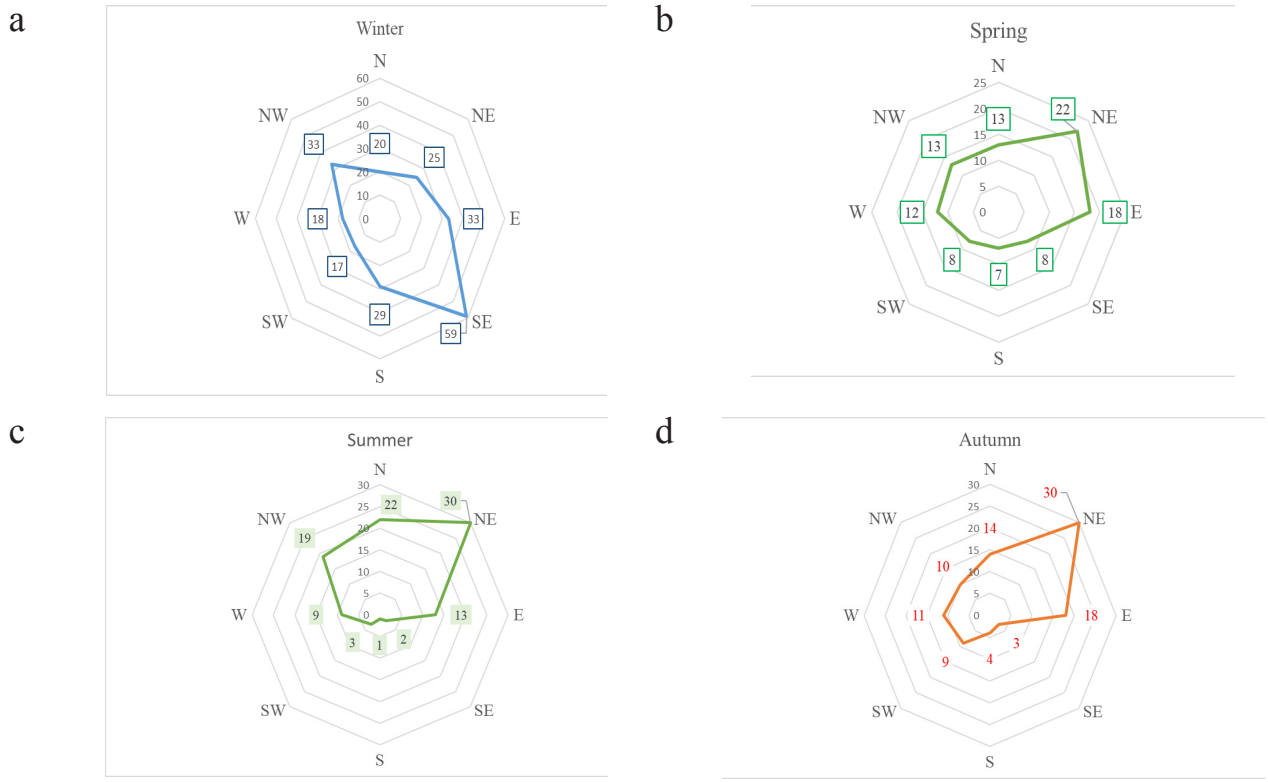

Figure 7 – Wind rose of repeatability (%) of wind directions by seasons at Akkum (Spravochik po klimatu Kazakhstana, 2005).

Table 7 – Average monthly repeatability (%) of weak (0-1 m/s) and strong (≥ 6 m/s) winds at Akkum

Wind speed gradation, m/s	Month												Year
	1	2	3	4	5	6	7	8	9	10	11	12	
0-1	50,2	48,7	45,4	40,0	36,9	35,6	32,9	36,2	51,3	56,9	58,5	55,6	45,7
≥ 6	6,8	6,6	6,7	10,0	9,0	9,1	10,7	9,5	5,1	4,4	3,9	3,9	7,2

One of the important points in the method of analyzing of the potential for the atmospheric air self-purification is the calculation of the repeatability of the surface delaying layers of atmosphere (R_{in}). The obtained value will allow us to estimate the coefficient of atmospheric self-purification (K) (Kabdykadyrov A.A. et al, 2021:308).

As a rule, an example of unfavorable meteorological conditions are surface temperature inversions. Taking into account the stable stratification of the atmosphere, they are retaining layers that prevent the dispersion and transfer of impurities in atmospheric air layers. Similar methods were used in the works (Arguchintseva A.V., Kochugova E.A., 2019:3; Perevedentsev Yu.P. et al., 2012:32; Belousova E.P. et al., 2023:73; Teterin A.F. et al, 2015).

Repeatability (R_{in}) is calculated using the regression equation. This equation for continental regions has the form:

$$R_{in}=31,4+0,29R_c, \quad (4)$$

In accordance with equation (4) and the climatic data of the Akkum, the surface delaying layers of atmosphere (R_{in}) were calculated (Table 8).

Table 8 – Average monthly repeatability of the surface delaying layers (R_{in}) on Akkum

Month												Year
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	
46,0	45,5	44,6	43,0	42,1	41,7	40,9	41,9	46,3	47,9	48,4	47,5	44,7

It can be seen (Table 8), that in Akkum, Rin is ranges from 40.9% (in July) to 48.4% (in December). In the cold period, the values of R_{in} are slightly higher than in the warm season. In the average annual value, R_{in} is 44.7%. Under these conditions, elevated levels of surface air concentrations may be observed.

In accordance with the values of R_{in} and based on long-term climatic data from Akkum, according to formulas (1) and (4), the indicators of the climatic potential of atmospheric pollution and the coefficient of atmospheric self-purification (K) (Kabdykadyrov A.A. et al, 2021:308; Gazaryan, V.A. et al., 2022:1) were calculated, the calculation results of which are given in Table 9. Since in the study area the repeatability of fogs (R_f) is low, instead of the value of R_f, the indicator (R_{in}) was used, according to the methodology (Selegey T.S. et al., 2015:725).

Table 9 – Indicators of CPAP and K for the area of Akkum

Indicators	Month												Year
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	
CPAP	6,2	6,2	5,2	3,3	3,4	3,6	2,9	3,8	9,9	10,5	10,9	10,3	6,4
K	0,09	0,08	0,10	0,15	0,14	0,13	0,15	0,12	0,05	0,05	0,05	0,05	0,10

For a visual representation of the results of calculations, in Figures 8 graphs of the annual variation of the coefficients of CPAP and K are plotted on Akkum.

An analysis of Figure 8a and Table 8 indicates that in the long-term aspect, the indicators of the CPAP in the entire annual course have a degree of extremely unfavorable conditions (CPAP > 2.4) for the atmospheric pollutants dispersion. The highest indicators of unfavorable weather conditions are observed in the cold period of the year (September-March), the coefficient is 5.2-10.9. In the warm season (April-August), this indicator is kept in gradations of 2.9-3.8. The generalizing provision on extremely unfavorable conditions shows the average annual value of the CPAP equal to 6.4.

According to Figure 8b and Table 9, the inverse CPAP self- purification coefficient K, which determines the conditions for the pollutant particles dispersion, also characterizes unfavorable conditions for the pollutant's dispersion throughout the entire annual cycle with the range from 0.05 to 0.15. Similarly to the CPAP indicator the cold period has more unfavorable conditions for dissipation in comparison with the warm period.

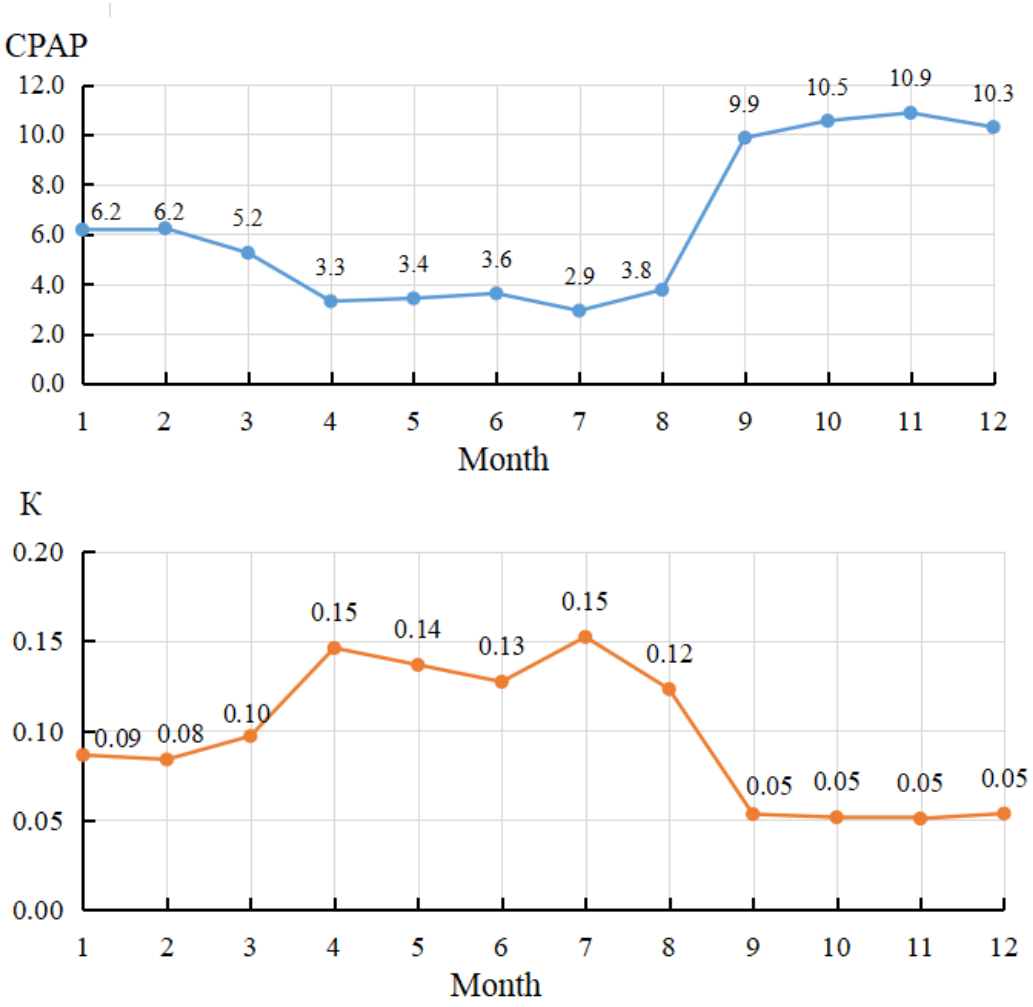

Figure 8 – Graph of the annual course of the CPAP coefficient and self-cleaning coefficient K at the meteorological station Akkum (Source: Compiled by the authors based on Akkum data (Spravochik po klimatu Kazakhstana, 2005, Selegey T.S.,et al, 2015:725))

Thus, during the study, the set goal was achieved and the hypothesis put forward was confirmed. It was noted that in the mine area in the period 1941-2020. observed an increase in average monthly air temperature with a warming rate of 0.19 to 0.34 °C every 10 years. The results of the analysis made it possible to identify unfavorable conditions for the dispersion of polluting particles in the atmospheric air throughout the entire annual cycle, which is associated with the processes of soil salinization and aridization. Taking into account the data obtained in the work in the future, when designing a tailing dump, it is important to assess the role of climatic factors in the distribution of heavy metals in the environment in the area of lead-zinc ore mining.

Conclusion

1. The analysis of changes in the meteorological and climatic factors' complex and their impact on the potential for atmospheric self-purification in the area of a lead-zinc mine indicates manifestations of atmospheric processes (natural and anthropogenic) that prevent the atmospheric pollutants dispersion.

2. It was noted that in the mine area in in the time course (1941-2020) every 10 years observed an increase in average monthly air temperature with a warming rate of 0.19 to 0.34 °C. At the same time, the greatest increase in temperature was noted in winter, and the smallest in summer.

3. It is shown that the anomalous air temperature field is large in the study area both in winter and summer months.

4. The data obtained according to the assessment of the spatiotemporal variability of CPAP (the climatic potential of atmospheric pollution) and the self-purification coefficient in the meteorological station Akkum, indicate unfavorable conditions for the dispersion of polluting particles in the atmospheric air throughout the entire annual cycle, which is associated with the aridization and soil salinization.

5. The obtained data should be taken into account in implementation of the air quality management in the industrial region.

References

Abdullah, N., Nysanbaeva, A., Abdirazak, A.(2024). Kyzylorda oblysyndagy aua temperaturasynyn 1961…2020 zhyldar aralygynda ozgerui [The temperature of the Kyzylorda region in 1961-2020. varies between]. Hydrometeorology and ecology, Vol.1, 65-76. doi: 10.54668/2789-6323-2024-112-1-65-78 (in Kazakh)

Adami, L. Boffadossi M. (2020). The effects of atmospheric stability on pollutant dispersion: analysis of the flow and the concentration field. Master's Degree thesis. URL. https://www.politesi.polimi.it/retrieve/a0e974b0-3974-4d26-8584-f97a89b936eb/2020_Adami.pdf

Asrar, G.R. (2019). Outlooks in geo-6-global environment outlook (geo-6): Healthy planet, healthy people chapter 19. New York: United Nations; 2019. URL. https://wedocs.unep.org/bitstream/handle/20.500.11822/27671/GEO6_CH19.pdf?sequence=1&isAllowed=y (accessed 31 July 2024)

Alexander, L. (2016). Global observed long-term changes in temperature and precipitation extremes: a review of progress and limitations in IPCC assessments and beyond. Weather Clim Extremes 11, 4–16.

Arguchintseva, A.V., Kochugova, E.A. (2019). Potencial samoochisheniya atmosphery // Izvestiya Irkutskogo gosudarstvennogo universiteta. [The potential of self-purification of the atmosphere] // Izvestiya Irkutsk State University. Earth Sciences Series (Seriya Nauka o Zemle), Vol.3, 3-15 (In Russian)

Assanov, D., Kerimray, A., Batkeyev, B., Kapsalyamova, Z. (2021). The Effects of COVID-19-related Driving Restrictions on Air Quality in an Industrial City. Aerosol Air Qual. Res. 21, 200663. doi: 10.4209/aaqr.200663

Bagrov, N.A., Myakisheva N.N. (1966). Nekotorye harakteristiki anomaliy srednih mesyachnyh temperatur vozduha [Some characteristics of anomalies of average monthly air temperatures]. Trudy MMTs, [Proceedings of the World Meteorological Center], Vol. 9, 53-63 (In Russian)

Belousova, E.P., Latysheva, I.V., Olemskoy, S.V.(2023). Current status of the temperature and humidity regime of the troposphere in the Siberian sector in different circulation periods Solar-Terrestrial Physics, Vol. 9. Iss. 1.P.73–79. doi: 10.12737/stp-91202309.

Demuzere, M., Trigo, R. M., Vila-Guerau de Arellano, J., Van Lipzig, N. P. M. (2009). The impact of weather and atmospheric circulation on O 3 and PM 10 levels at a rural mid-latitude site. Atmospheric Chemistry and Physics, 9(8), 2695-2714.

ErshibulovA.K. (2016). Pyl'nye buri v prikaspijskom regione Respubliki Kazakhstan [Dust storms in the Caspian region of the Republic of Kazakhstan] // Scientific Almanac of the France-Kazakhstan Association,// Nauchnyj almanah assotsiatsii France-Kazakhstan, No3, 125-135 (In Russian)

Geldyeva, G.V., Budnikova, T.I., Skorintseva, I.B., Basova, T.A., Tokmaganbetova, R.V. Plohih, Yu.(2004). Landshaftnoe obespechenie shemy borby s opustynivaniem doliny reki Syrdarya. [Landscape support of the scheme for combating desertification of the Syrdarya River valley]. Almaty:Arkas, 236p (in Russian)

Gazaryan, V.A.,Kudryavtsev,P.I.,Bezrukova,A.V.,Kurbatova, Y. A. Shapkina N. E.,Chulichkov,A. I. (2022). Statistical analysis of the surface layer air temperature time series in various regions of Russia, *2022 VIII International Conference on Information Technology and Nanotechnology (ITNT)*, Russian Federation: Samara, 1-6, doi: 10.1109/ITNT55410.2022.9848747

Golokhvast, K.S., Kiku, P.F., Khristoforova, N.K. (2012). Atmospheric suspensions and human ecology. Ekologiya cheloveka (Human Ecology), 19(10), 5-10. doi: 10.17816/humeco17418 (in Russian)

Gruza, G.V., Rankova, E.Ya. (2012). Nablyudaemye i ozhidaemye izmeneniya klimata Rossii: temperatura vozdukha [Observed and Expected Climate Changes over Russia: Surface Air Temperature]. Obninsk, FGBU "VNIIGMI- MTsD" Publ., 194p (In Russian).

Kabdykadyrov, A.A., Zubova, O.A., Mukanova, G.A., Dauletbaeva, M.M., Voronova, N.V. (2021). Klimaticheskiy potencial samoochisheniya atmosphery v g.Ust-Kamenogorske [The climatic potential of self-purification of the atmosphere in Ust-Kamenogorsk]. QazBSQA Habarshysy Injenerlik jueler jane ekologiya,Vol. 1(79), 308-315. doi: 10.51488/1680-080X/2021.1-38 (in Russian)

Kogan, F., Guo, W. (2014). Early twenty-first-century droughts during the warmest climate. Geomat Nat Hazards Risk 7(1):127–137. doi: 10.1080/19475705.2013.878399

Korotkova, N.V., Semenova, N.V. (2014). Meteorologicheskiy potencial samoochisheniya atmosphery v Saratove [Meteorological potential of self-purification of the atmosphere in Saratov]. Saratov: Saratov University Press (Izdatelstvo Saratovskogo universiteta), 194-201 (in Russian)

Kozhagulov, S.O., Salnikov, V.G. (2023). Air quality management in the development of mining deposits. Journal of Geography & Environmental Management, 71(4). doi: 10.26577/JGEM.2023.v71.i4.09

Krymskaya, O.V., Lebedeva, M.G., Buzakova, I.V., Storozhilova, S.Yu. (2016). Meteorologicheskij potentsial samoochisheniya vozduha v Belgorodsroj oblasti [Meteorological potential of self-purification of air in the Belgorod region]-// Scientific bulletin of Belgorod University. Series: Natural sciences, (Nauchnye vedomosti Belgorodskogo universiteta.Seriya:Estestvennye nauki), Vol.4(225), 124-129 (in Russian)

Lai, H.C., Dai, Y.T., Mkasimongwa, S.W., Hsiao, M.C., Lai, L.W. (2023). The impact of atmospheric synoptic weather condition and long-range transportation of air mass on extreme PM10 concentration events. Atmosphere, 14(2), 406. doi: 10.3390/atmos14020406

Lapina, S.N., Polyanskaya, E.A., Fetisova, L.M., Fetisova, H.A.(2008) Sposobnost atmosphery razlichnyh raionov Saratovskoy oblasti k samoochisheniyu [The ability of the atmosphere of various districts of the Saratov region to self-purify] // Proceedings of the Saratov University (Izvestiya Saratovskogo universiteta), Vol.2, 8-11. doi: 10.18500/1819-7663-2008-8-2-8-11 (in Russian)

Mohr, S., Giurco, D., Retamal, M., Mason, L., Mudd, G.(2018) Global Projection of Lead-Zinc Supply from Known Resources. Resources, 2018, 7(1), 17. doi: 10.3390/resources7010017

Morozov, A.E., Starodubtseva, N.I.(2020) Meteorologicheskie ysloviya zagryazneniya atmosphery [Meteorological conditions of air pollution]. Ekaterinburg: UGLTU , 123 p (in Russian)

Mudd, G.M., Jowitt, S.M., Werner, T.T. (2017). The world's lead-zinc mineral resources: scarcity, data, issues and opportunities. Ore Geology Reviews, 80, 1160-1190. doi: 10.1016/j.oregeorev.2016.08.010.

National Research Council (NRC) (2020) Climate change: evidence and causes: update 2020. The National Academies Press, Washington, DC. URL: https://royalsociety.org/-/media/education/teacher-consultant-resources/climate-change-evidence-causes.pdf (accessed 31 July 2024)

ND RK (2022) Nacional'nyj doklad o sostoyanii okruzhayushchej sredy i ob ispol'zovanii prirodnyh resursov Respubliki Kazahstan za 2022 god. [National report on the state of the environment and on the use of natural resources of the Republic of Kazakhstan in 2022]. Astana, 2023 URL: https://www.gov. kz/memleket/entities/ecogeo/documents/details/383692?lang=ru (accessed 31 July 2024) (in Russian)

Omuto, C. T., Scherstjanoi, M., Kader, M. A., Musana, B., Barman, A., Fantappiè, M., Matolo, N. (2023). Harmonization service and global library of models to support country-driven global information on salt-affected soils. Scientific reports, 13(1), 13157. doi: 10.1038/s41598-023-40078-9

Perevedentsev, Yu.P., Khabutdinov, Yu.G.(2012) Meteorologichesky potencial samoochisheniya i kachestvo atmosphernogo vozduha v Kazani v poslednie decyatiletiya. [Meteorological possibilities of self-purification and atmospheric air quality in Kazan in recent decades]. Bulletin of Udmurt University, 2012, Vol. 3, 23-28 (in Russian)

Perevedentsev, Yu.P. Sherstyukov, B.G., Shantalinsky, K.M., Guryanov, V.V. (2019) Sovremennye klimaticheskie izmeneniyav tropo-stratosphere i vzaimodejstvie mezhdu sloyami [Modern climatic changes in the tropo-stratosphere and the interaction between layers] International Young Scientists School and Conference on Computational Information Technologies for Environmental Sciences CITES 2019 27 May – 6 June 2019. Moscow, Russia, 32-34 (in Russian)

Prabhakar, G., Sorooshian, A., Toffol, E., Arellano, A. F., Betterton, E. A. (2014). Spatiotemporal distribution of airborne particulate metals and metalloids in a populated arid region. Atmospheric environment, 92, 339-347. doi: 10.1016/j.atmosenv.2014.04.044

Punia, A. (2021) Role of temperature, wind, and precipitation in heavy metal contamination at copper mines: a review.Environmental. Science and Pollution Research, Vol. 28, 4056–4072. doi: 10.1007/s11356-020-11580-8

Salnikov, V.G. (2006) Ecologo-klimatichesky potencyal Kazakhstana. [Ecological and climatic potential of Kazakhstan] Monography. -Almaty: Kazak universitety, 230 p (in Russian)

Salnikov. V., Kozhagulov, S., Rysmagambetova, A. (2024) Management of atmospheric air quality at mining fields based on ESG principles. Technoeconomics, 3.1 (8), 71–80. doi: 10.57809/2024.3.1.8.7

Santer, B.D., Stephen, P.C., Zelinka, M.D. (2018) Human infuence on the seasonal cycle of tropospheric temperature. Science 361: 6399. doi: 10.1126/science.aas8806

Selegey, T.S., Filonenko, N.N., Lenkovskaya, T.N. (2015) O metodike opredeleniya meteorologicheskogo potencyala zagryazneniya atmosphery. [On the methodology for determining the meteorological potential of atmospheric pollution].Optics of the atmosphere and ocean (Optica atmosphery i okeana), Vol.8, 725-729 (in Russian)

Spravochik po klimatu Kazakhstana. Atmosphernye yavleniya. [Handbook on the climate of Kazakhstan. Atmospheric phenomena].-p.3.Issue 11.-(R.3. Vol.11). Almaty: RGP "Kazgidromet", 41p. doi: 10.18500/1819-7663-2008-8-2-8-11 (in Russian)

Spravochik po klimatu Kazakhstana.Atmosphernye osadki– R.2. Vyp..11, [Handbook on the climate of Kazakhstan]Almaty: RGP "Kazgidromet", 32p (in Russian)

Spravochik po klimatu Kazakhstana Veter. Atmosphernoe davlenie – R.5-6., Vyp. 1-14. [Handbook on the climate of Kazakhstan Wind. Atmospheric pressure – p.5-6., Issue 1-14.]. Almaty: RGP "Kazgidromet", 336p. (in Russian)

Spravochik po klimatu Kazakhstana. Mnogoletnie dannye 1981-2010 gg. [Handbook on the climate of Kazakhstan. Long-term data 1981-2010]. (2011). Astana: RGP "Kazgidromet", 40p (in Russian)

Stambekov M.D., Turulina G.K. (2016). Osobennosti temperatyrnogo rezhima na Zapade Ii Vostoke Kazakhstana vesnoi v poslednie desyatiletiya. [Features of the temperature regime in the West and East of Kazakhstan in spring in recent decades.] Hydrometeorology and Ecology, (Gidrometeorologiya i Ecologiya), Vol. 4 (83), 7-23 (in Russian)

Chen, T., Wen, X. C., Zhang, L. J., Tu, S. C., Zhang, J. H., Sun, R. N., Yan, B. (2022). The geochemical and mineralogical controls on the release characteristics of potentially toxic elements from lead/zinc (Pb/Zn) mine tailings. Environmental Pollution, 315, 120328. doi: 10.1016/j.envpol.2022.120328.

Teterin, A.F., Merkelov, Yu.I., Vorozhnin, V.S. (2012). Klimatichesky potencial rasseivaniya atmosphery na territorii Urala [The climatic potential of atmospheric dispersion in the Urals]//Bulletin of Nizhnevartovsk State University (Vestnik Nijnevartovskogo gos.universiteta), Vol. 1. (in Russian)

Wang, H., Ju, C., Zhou, M., Chen, J., Kan, X., Dong, Y., Hou, H. (2022). Acid rain-dependent detailed leaching characteristics and simultaneous immobilization of Pb, Zn, Cr, and Cd from hazardous lead-zinc tailing. Environmental Pollution, 307, 119529.

Whaley, P, Nieuwenhuijsen, M, Burns, J, editors (2021). Update of the WHO global air quality guidelines: systematic reviews. Environ Int. 142 (Special issue). URL. https://www. sciencedirect.com/journal/environment-international/special-issue/10MTC4W8FXJ (accessed 31 July 2024).

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РЕКРЕЦИЯЛЫҚ ГЕОГРАФИЯ ЖӘНЕ ТУРИЗМ

Section 4

RECREATION GEOGRAPHY AND TOURISM

Раздел 4

РЕКРЕАЦИОННАЯ ГЕОГРАФИЯ И ТУРИЗМ

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CHALLENGES OF THE 21ST CENTURY IN THE CONTEXT OF SUSTAINABLE TOURISM IN A HUNGARIAN INDUSTRIAL CITY

The aim of our research is to show how Székesfehérvár, an industrial city in Hungary, can adapt to the challenges of the 21st century in the field of sustainability from the perspective of tourism. The city has launched a number of initiatives that directly address the sustainability of tourism. These projects include the expansion of green spaces, the promotion of environmentally friendly transport solutions and the protection of the local economy and heritage. A key element in the development of sustainable tourism is raising environmental awareness, which includes the organisation of educational programmes and community events to promote sustainable lifestyles among residents and visitors. Our research looked at how sustainability is integrated into the city's tourism-related developments and how this approach is becoming a key element of urban development. In our analysis, we look in detail at specific projects and programmes that have been implemented in Székesfehérvár in the context of sustainability, and assess their effectiveness, challenges and reception by residents and tourists.

Key words: Hungary, Székesfehérvár, tourism, climate protection, sustainability.

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Венгрияның өнеркәсіптік қаласындағы тұрақты туризм контекстіндегі XXI ғасырдың қиындықтары

Біздің зерттеуіміздің мақсаты – Венгрияның өнеркәсіптік қаласы Секешфехервардың туризм тұрғысынан тұрақтылық саласындағы XXI ғасырдағы қиындықтарға қалай бейімделе алатынын көрсету. Қала туризмнің тұрақтылығын тікелей шешуге бағытталған бірқатар бастамаларды қолға алды. Бұл жобалар жасыл аумақтарды кеңейту, экологиялық таза көлік шешімдерін ілгерілету және жергілікті экономика мен мұраны қорғауды қамтиды. Тұрақты туризмді дамытудың негізгі элементі тұрғындар мен келушілер арасында тұрақты өмір салтын насихаттау үшін білім беру бағдарламалары мен қоғамдық іс-шараларды ұйымдастыруды қамтитын экологиялық хабардарлықты арттыру болып табылады. Біздің зерттеуіміз тұрақтылық қаланың туризммен байланысты дамуымен қалай біріктірілгенін және бұл тәсіл қалайша қала дамуының негізгі элементіне айналғанын қарастырды. Талдауымызда біз Секешфехерварда тұрақтылық контекстінде жүзеге асырылған нақты жобалар мен бағдарламаларды егжей-тегжейлі қарастырамыз және олардың тиімділігін, қиындықтарын және тұрғындар мен туристерді қабылдауын бағалаймыз. Нәтижелер қала өмір сүру сапасын жақсарту және экологиялық әсерді азайту бойынша айтарлықтай жетістіктерді көрсетті. Сонымен қатар, болашақ дамудың мүмкіндіктері мен перспективалары көп. Бұл жобалар қаланың тұрақты дамуына маңызды үлес қосады. Қала үшін ұзақ мерзімді артықшылықтар қамтамасыз етіледі.

Түйін сөздер: Венгрия, Секешфехервар, туризм, климатты қорғау, тұрақтылық.

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Вызовы XXI века в контексте устойчивого туризма в венгерском промышленном городе

Цель нашего исследования – показать, как Секешфехервар, промышленный город в Венгрии, может адаптироваться к вызовам XXI века в области устойчивого развития с точки зрения туризма. Город запустил ряд инициатив, которые непосредственно касаются устойчивости туризма. Эти проекты включают в себя расширение зеленых зон, продвижение экологически чистых транспортных решений, защиту местной экономики и наследия. Ключевым элементом развития устойчивого туризма является повышение экологической осведомленности, что включает в себя организацию образовательных программ и общественных мероприятий, направленных на пропаганду устойчивого образа жизни среди жителей и гостей города. В нашем исследовании мы рассмотрели, как устойчивое развитие интегрировано в городские проекты, связанные с туризмом, и как этот подход становится ключевым элементом городского развития. В нашем анализе мы подробно рассматриваем конкретные проекты и программы, которые были реализованы в Секешфехерваре в контексте устойчивого развития, и оцениваем их эффективность, проблемы и восприятие жителями и туристами. Результаты показали значительное улучшение качества жизни и снижение экологического воздействия. Перспективы дальнейшего развития многообещающие.

Ключевые слова: Венгрия, Секешфехервар, туризм, защита климата, устойчивое развитие.

Introduction

Székesfehérvár is located in Central Transdanubia, the seat of Fejér County, a city with county rights. It is situated at the junction of two geographical regions: the Mezőföld and the Transdanubian Central Mountains. It is one of the most important towns in the history of Hungary, a coronation town, one of the capitals of the Kingdom of Hungary in the Middle Ages, and the royal seat. It is therefore extremely rich in monuments and an important economic, railway and road hub. It is one of the most developed industrial cities in Hungary and has a lively sporting and cultural life.

According to the study of Szendi and Sikos (Sikos T., Szendi D., 2023:88) -which aims to investigate sustainability and the smart economy- the city belongs to the cluster group of emerging, dynamic and liveable cities, the eighth most liveable Hungarian county city.

In our analysis, we examined how Székesfehérvár, an industrial city in Hungary, can adapt to the challenges of the 21st century in the field of sustainability, with a special focus on tourism. In our study we analysed several recent developments in order to examine their contribution to the sustainable development of the city. These developments include the Green City – Lungs of Fehérvár project, the Palotaváros Lakes Recreation Park and the development of the Sóstó Visitor Centre, all of which represent a significant step forward in the development of the city's green infrastructure and in making tourism more sustainable.

In assessing the projects examined, particular attention was paid to how they fit into the city's long-term sustainability strategy and their impact on the local community and tourism. The analysis found that Székesfehérvár has made significant progress in the development of sustainable tourism and green infrastructure, which contribute to the preservation of the city's cultural and natural heritage and to improving the quality of life for tourists and local residents.

The aim of the research is to show how Székesfehérvár, an industrial city in Hungary, can adapt to the sustainability challenges of the 21st century in terms of tourism. The city has launched a number of initiatives to promote sustainable tourism, such as the expansion of green spaces, the promotion of environmentally friendly transport solutions and the protection of the local economy and heritage. A key element in the development of sustainable tourism is raising environmental awareness, which includes the organisation of educational programmes and community events.

The scientific significance and practical relevance of the research lies in the detailed analysis of the sustainability efforts of Székesfehérvár and

their impact on tourism and urban development in the city. Its practical significance is that it presents concrete examples and methods that can be applied to other cities in the design and development of sustainable tourism.

Material and method

The research aimed to answer how Székesfehérvár, an industrial city in Hungary, can adapt to the sustainability challenges of the 21st century through tourism development.

The hypothesis posited that the implementation of sustainable tourism practices and infrastructure developments in Székesfehérvár can significantly enhance the city's environmental, economic, and social sustainability.

Primary and secondary sources were used for the research. Primary data were collected from the website of the Municipality of Székesfehérvár and through direct observations. Secondary data were analysed based on a literature review. For the qualitative analysis, we conducted a content analysis of the city's website and used the field visit method to understand the recreational experiences offered by these sites.

The research was conducted in several phases:

- Literature Review: analyzing existing studies on sustainable tourism, focusing on methodologies and findings relevant to urban settings.
- Data Collection: gathering data from municipal records and direct field observations.
- Content analysis: performing a content analysis of the city's tourism and development projects as documented on the official website.
- Field Visits: conducting site visits to project locations, to observe and record the implementation and impact of these initiatives.
- Qualitative Analysis: used to assess the effectiveness of tourism projects in terms of sustainability goals.

The research confirmed that Székesfehérvár's sustainable tourism initiatives have positively impacted the city's environmental quality, community engagement, and overall urban sustainability. The results support the hypothesis that targeted sustainable tourism projects can effectively address urban sustainability challenges.

This methodological approach allowed us to get a comprehensive picture of the role of the excursion sites and recreational spaces in Székesfehérvár in sustainable tourism.

Literature analysis

The coronavirus epidemic has brought people closer to nature again, which according to Benjamin et al. (Benjamin S. et al., 2020:476) has helped to increase interest in sustainable tourism. In addition, El Archi et al. (El Archi Y. et al., 2023:1) have shown that more and more people are paying attention to reducing their environmental footprint and promoting the SDGs. Matos observed (Matos R., 2004:93) that sustainability and behavioural changes in tourism contribute to the concept of sustainable tourism. This is further extended by Conway and Timms (Conway D., Timms B.F., 2010:329) to include aspects of environmental protection, economic growth and social justice.

Accessibility plays an important role in tourists' choice of destinations, as highlighted by Tóth-Dávid-Vasa (Tóth G. et al., 2014:311). The unique identity of a destination is essential for travelers, increasing its attractiveness and competitiveness, as Piskóti et al. (Piskóti I. et al., 2023:55) note. According to Park and Kim (Park E., Kim S., 2016:351), local resources as assets are at the heart of tourism valorisation, while Petrini (Petrini S., 2007:304) stresses that it is during the journey that the experience is gained. The work of Tóth, Kaszás and Keller (Tóth N. et al., 2018:47) highlights the role of environmental sustainability in this context, which is an essential element of modern tourism. Thus, it is clear that sustainable tourism practices and related attitudinal changes play an important role in shaping current tourism trends (Dávid L. et al., 2012:236)], focusing on environmental protection, economic development and social justice. This relates to the findings of Alreahi et al. (Alreahi M. et al., 2023:25) who emphasise the need to improve environmental stewardship and strive for sustainability

Results

The Green City – Lungs of Fehérvár programme is one of the largest climate protection projects in Székesfehérvár, which also has a recreational and tourist purpose. The development aims to counterbalance the city's extensive development with a large-scale green and recreational area development. The forest and park development promotes leisure and recreation by planting 868 park and row trees on 30 hectares, planting 15 hectares of forestry seedlings and preserving the natural primeval grassland for its valuable wildlife. In addi-

tion, a service building of 200 m^2 with cafeteria and toilets; a parking lot for 50 cars; a 6 km long footpath with gravel/crushed stone pavement; a 3 km long footpath with dirt track; and a grassed area were constructed. A primary consideration in the development was to ensure that the green space is accommodating other infrastructure, which is different from the usual case, as green space is usually an additional element of infrastructure. It has opened only in September 2023, so it is now starting to be explored and used by locals and visitors alike as shown in Figure 1.

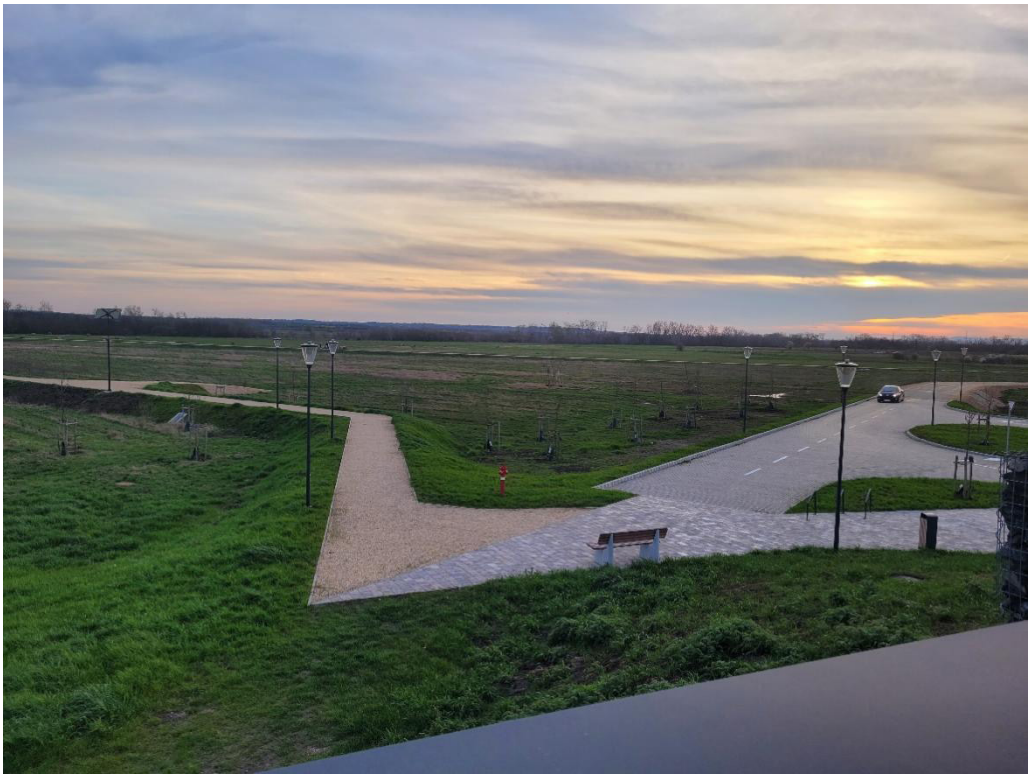

Figure 1 – The Green City-Lung of Fehérvár project
(*Source: own photo)*

A little further from the city centre, but still a few minutes' walk away, is the Palotaváros Lakes Leisure Park as shown in Figure 2. The development will meet the needs of visitors for a healthy living space and provide a cultivated environment for active leisure. There is a fitness park, a gym, a road safety course and a playground. Around the South Lake there is a mixed-use grassy walkway for cycling, running and walking, a bike park, basketball and football pitches. The *recreation park is a natural setting for people to meet, play sports and organise activities. The* implementation of the project will help to achieve the objectives of improving and reducing the ecological and environmental pressures caused by industrial activity and of providing recreational facilities for residents and tourists by improving the quality of the urban environment and infrastructure in Székesfehérvár. On the eastern side of the southern lake, an events area, a cooking area, a small playground and sports fields (basketball and football pitches) have been created, while on the western side of the lake a dirt-bringing park has been developed. A mixed-use (cycling, running, walking) gravel walkway has also been created around the lake. Next to the northern lake, a fitness park, a fitness park for disabled people, a road safety course, a playground and a dog run have been built. It is a well-known place for fishing competitons, lot of national and international events are organized here and angling tourism is also developing.

Figure 2 – The Palotaváros Lakes Leisure Park
(*Source: own photo)*

The Sóstó is located in the southern part of the city as shown in Figure 3, in the inner area of Székesfehérvár, which is formed by the 121 ha nationally protected Sóstó-Sand Mine Nature Reserve and the 97 ha locally protected Sóstó Nature Reserve. Sóstó is situated on the border between three different landscapes. The western side of the area is bordered by marshy mudflats, the southern side by the sandy, loamy landscapes of the Northern Fields, the northern side by the city of Székesfehérvár and, further north, by the Zámoly basin. The restoration of the nature reserve has resulted in the enhancement of natural processes, the preservation of the natural state, the protection of wetlands and the conservation of biodiversity. Ornithological surveys have confirmed the presence of more than 70 nesting species in the area. The area is of considerable botanical value. The number of protected plant species is in the thousands. The Sóstó Wildlife Centre plays a unique role in animal rescue and rehabilitation at national level, and visitors can gain an insight into this. The aim of the rehabilitation and education is to return the animals to the wild, preceded by a long period of indoor and outdoor rehabilitation. Animals that cannot be released due to permanent injury are kept in the best possible conditions and shown up close and personal. Visitors can also gain insight into the treatment process through open glass panels.

The Visitor Centre features an interactive presentation of the unique bird and plant life of the 200-hectare Sóstó nature reserve. Ecotours are held regularly, where visitors can learn about the fauna and flora of the nature trail with a professional guide. The Visitor Centre is housed in the impressive stadium of Fehérvár FC, which is also the home of the football club. The Visitor Centre also offers a wide range of activities. Young people can enjoy colourful, interactive activities to improve their knowledge and creativity and get closer to nature. Visitors can also take part in theme days, guided eco-tours led by experts, or explore the kilometres of green space, walking trails, nature trails and birdwatching trails on their own.

Figure 3 – Sóstó Székesfehérvár
(*Source: https://turizmus.szekesfehervar.hu/)*

Discussion and conclusion

The results of this study indicate significant advancements in Székesfehérvár's approach to sustainable tourism. The implementation of projects such as the Green City – Lungs of Fehérvár, Palotaváros Lakes Leisure Park, and the Sóstó Visitor Centre showcases the city's commitment to integrating sustainability into urban development.

Comparing these results with previous studies (Benjamin S. et al., 2020:476), it is evident that Székesfehérvár's initiatives align well with global trends in sustainable tourism. El Archi et al. (El Archi, 2023:1) emphasized the role of smart tourism in sustainable development, which is reflected in the interactive and educational elements of the Sóstó Visitor Centre. The integration of technology and education in this project aligns with global best practices, making environmental education accessible and engaging for a wide audience.

The Palotaváros Lakes Leisure Park supports the findings of Matos (Matos R., 2004:93) and Conway and Timms (Conway D., Timms B.F., 2010:329) , who advocated for the development of leisure spaces that promote a slow, sustainable approach to tourism. This park not only provides recreational facilities but also serves as a community hub, fostering social cohesion and active lifestyles.

Today, awareness-raising is of paramount importance, with a wide range of tools to reach a broad audience. Today, it is receiving more and more attention and is becoming increasingly prominent. Children and young people (Seres Z., 2019:34) are a particular target group for awareness-raising activities, since if they learn about the effects of climate change and the importance of protecting the environment and nature at an early age, they will be better able to protect it as adults. Given that this age group is already using various communication and entertainment tools, it is also easier to access them in everyday life. These recreational areas also play an important role in shaping attitudes.

It is important that the communication emphasises the following when shaping attitudes:

- Health promotion, health protection
- Adverse effects of climate change
- Individual responsibility
- Individual action can contribute to improving quality of life and preserving a better quality environment
- Personal benefits, cost reduction
- Warning on climatic extremes

Through green space developments, Székesfehérvár aims to increase biodiversity, improve the urban climate and reduce the heat island effect. These are of great importance for an industrial city, as they offset the harmful emissions of industry with large-scale green space developments, which are also of paramount importance for climate protection. On the other hand, new recreational areas for tourists and locals will be created, which will provide a new attraction alongside the cultural heritage (Dávid L. et al., 2009:482), thus increasing the tourism value of the city.

To sum up, the city is constantly keeping climate protection and recreational aspects in mind in both its tourism development and daily operations. The municipality aims to preserve a liveable environment for future generations and to reduce greenhouse gas emissions by implementing environmentally friendly tourism developments. The protection of natural assets, increasing the quantity and quality of green spaces and combating the climate crisis are priorities in the life of the town, as they play a vital role in improving the quality of life and the urban climate and preserving natural diversity.

This study aligns with findings by Dadkhah et al. (Dadkhah M. et al., 2024:13) on the integration of emerging technologies for sustainable development goals, highlighting the need for innovative approaches in urban sustainability. Additionally, the emphasis on local community engagement and sustainable practices is consistent with the systematic review by Dávid and El Archi (Dávid L.D., El Archi Y., 2024:13) which underscores the importance of community involvement in sustainable tourism development. Furthermore, these initiatives support the broader objectives of sustainability as outlined in the comprehensive review by El Archi et al. on smart tourism destinations. The practical application of these sustainable strategies in urban settings is further echoed in Priatmoko et al. (Priatmoko S. et al., 2021:13) which explores sustainable urban development and the integration of green infrastructure. The concept of sustainable tourism is also discussed by Baros and Dávid (Dávid L.D., Baros Z., 2007:349), who emphasize the importance of balancing the needs of current tourists and hosts with the protection and enhancement of opportunities for future generations, highlighting the interconnectedness of environmental, economic, and social dimensions of sustainability. Additionally, Zhu et al. (Zhu K. et al., 2023:22) examine the balance between tourism development and ecological pressure in the Yangtze River basin, demonstrating the importance of harmonizing economic growth with environmental sustainability in regional tourism.

The research contributes to the field of sustainable tourism by showing in detail, through the example of Székesfehérvár, how sustainability can be integrated into urban tourism. The city has made notable progress in sustainable urban tourism. It's comprehensive approach aligns well with global best practices, highlighting the importance of green spaces, environmental awareness, and community involvement in achieving sustainability goals. These efforts have improved the quality of life for residents and visitors and contributed to the preservation of cultural and natural heritage. The research can help the academic community and policy makers to understand and apply sustainable tourism practices in different urban contexts.

The practical relevance of the research is that the projects and programmes presented will provide concrete guidance for other cities to implement sustainable tourism. The projects provide a model for other cities aiming to enhance sustainability in urban tourism. The results show that improving green spaces, raising environmental awareness and encouraging community participation can contribute significantly to improving the quality of life in cities and to the success of sustainable tourism. Such developments can result in long-term economic benefits, improved community relations and a reduced environmental footprint, as well as increasing environmental awareness and active participation in sustainability efforts by local residents and tourists.

References

Alreahi, M., Bujdosó, Z., Kabil, M., Akaak, A., Benkó, K.F., Setioningtyas, W.P., Dávid, L.D. (2023). Green Human Resources Management in the Hotel Industry: a Systematic Review, Sustainability, 15:1: 99 , 25.

Benjamin, S., Dillette, A., Alderman, D. H. (2020). "We can't return to normal": committing to tourism equity in the post-pandemic age. Tourism Geographies, 22(3), 476-483. doi: 10.1080/14616688.2020.1759130

Conway, D., Timms, B.F. (2010). Re-branding alternative tourism in the Caribbean: The case for „ slow tourism." Tourism and Hospitality Research, 10(4), 329-344.

Dadkhah, M., Nedungadi, P., Raman, R., David, L. D. (2024). Emerging and disruptive technologies and the sustainable development goals: A state of art and research agenda. Equilibrium. Quarterly Journal of Economics and Economic Policy, 19(1), 13–21. doi: 10.24136/eq.2985

Dávid L., Tóth, G., Kincses, Á., Kelemen, N., Kovács, B. (2009). A turizmus szerepe a regionális fejlődésben: Az Észak-Magyarország Régió, az I. Nemzeti Fejlesztési Terv 2004-2006 és az Új Magyarország Fejlesztési Terv ÚMFT 2007-2013 alapján [The role of tourism in regional development: the North Hungary Region, based on the 1st National Development Plan 2004-2006 and the New Hungary Development Plan 2007-2013], Károly Róbert College, Gyöngyös, 482 p.

Dávid, L., Vargáné, Cs., K., Kovács, Gy., Vasa, L. (2012). Turizmusökológia: zöldülő turizmus-fenntartható turizmusfejlesztés [Tourism ecology: greening tourism-sustainable tourism development], Szaktudás Kiadó, Budapest, Hungary, 236p.

Dávid, L.D., Baros, Z. (2007). A possible use of indicators for sustainable development in tourism. Anatolia: An International Journal of Tourism and Hospitality Research, 18:2, 349-355. doi: 10.1080/13032917.2007.9687211

Dávid, L.D., El Archi, Y. (2024). Beyond boundaries: Navigating smart economy through the lens of tourism. Oeconomia Copernicana, 15(1), 13–25. doi: 10.24136/ oc.2978

El Archi, Y., Benbba, B., Nizamatdinova, Z., Issakov, Y., Vargáné, G.I., Dávid, L.D. (2023). Systematic literature review analysing smart tourism destinations in context of sustainable development: current applications and future directions. Sustainability 15(6), Paper: 5086, 1-15. doi: 10.3390/su15065086

Matos, R. (2004). Can „slow tourism" bring new life to Alpine regions? in K. Weimar & C. Mathies (Eds.), The tourism and leisure industry: shaping the future. New York: Routledge, pp. 93-104.

Park, E., Kim, S. (2016). The potential of Citta slow for sustainable tourism development: enhancing local community's empowerment. Tourism Planning and Development. 13(3), 351-369. doi: 10.1080/21568316.2015.1114015

Petrini, C. (2007). Slow Food Nation, New York: Rizzoli Ex Libris. 304 p.

Piskóti, I., Marien, A., Papp, A., Nagy, K. (2023). Slow és turizmus – a kisvárosfejlesztési alternatíva!?, Slow and tourism – the alternative for small town development!? The Hungarian Journal of Marketing and Management 552023 / Special Issue EMOK 2, 55-64. doi: 10.15170/MM.2023.57.KSZ.02.06 2023/különszám

Priatmoko, S., Kabil M., Vasa L., Pallás E.I. , Dávid L.D. (2021). Reviving an Unpopular Tourism Destination through the Placemaking Approach: Case Study of Ngawen Temple, Indonesia, Sustainability, 2021, 13, 6704. doi: 10.3390/su13126704

Seres, Z. (2019). Környezeti szemléletformálás –A fenntarthatóság témakörének feldolgozási módszerei és eszközei a földrajztanításban, Environmental awareness raising – A sustainablility theme processing methods and tools in geography teaching, Pedagógiai Folyóiratok, 2019/9-10, 34-57.

Sikos T., Szendi, D. (2023). A hazai megyei jogú városok gazdasági és környezeti fenntarthatóságának mérése, Measuring the Economic and Environmental Sustainability of Hungarian Cities with County Rights, 2020-2021, Területi Statisztika, 2023, 63(1): 88–124; doi: 10.15196/TS630104

Tóth, G., Dávid, L.D., Vasa, L. (2014). The role of transport European tourism flows, Acta Geographica Slovenica, 54:2, 311-320, URL. https://ojs.zrc-sazu.si/ags/article/view/1915

Tóth, N., Kaszás, N., Keller, K. (2018). Turizmus a helyi termékek nyomában, avagy egy határon átnyúló tematikus út kialakításának lehetőségei, Tourism in the footsteps of local products, or the possibilities of developing a cross-border thematic route. Marketing and Management. 52(2), 47-58.

Zhu, K., Quan, Z., Chen, Y., Zhang, Y., Li, T.; Yan, X., Alimov, A., Farmanov, E.. Dávid, L.D. (2023). Regional sustainability: pressures and responses of tourism economy and ecological environment in the Yangtze River basin, China. Frontiers in Ecology and Evolution, 11., 22. doi: 10.3389/fevo.2023.1148868

Websites

Official website of Sóstó Visitor Centre, accessed 03.02.2024.

Official website of the Municipiality of Székesfehérvár, www.szekesfehervar.hu accessed 03.05.2024.

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MODERN METHODOLOGY OF DESIGNING A TRAVEL COMPANY IN THE REPUBLIC OF KAZAKHSTAN

Modern development of the tourism industry in the Republic of Kazakhstan is a rather active and intensive process, the main task of which is the gradual development of tourism in the country, corresponding to regional and international requirements of the tourism business and the provision of a full range of tourist services of different levels and directions. The purpose of the research, outlined in the article, was the process of formation of a modern methodology of designing a tourism company, based on the practical experience of the authors for more than ten years. The authors studied and analyzed the main regulatory and legislative documents that have a direct impact on the development of tourism in the country, as well as reports of leading tourism organizations of the country. Modern trends in the market of the service sector were studied, a large-scale survey of both the actors of the tourism industry and consumers of tourism services was conducted. The authors prepared a qualitative algorithm for creating a tourism company, which was the result of practical activity in the field of opening and successful management of tourism business from 2012 to the present. These studies, outlined in the article, will allow not only to form a qualitative idea of the current stage of tourism development in the Republic of Kazakhstan, but also give the opportunity to use the algorithm of opening a tourism company to build a successful tourism business in Europe.

Key words: tourism, tourism company, tourism business, tourism services, tourism industry.

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Қазақстан Республикасындағы туристік компанияны жобалаудың заманауи әдістемесі

Қазақстан Республикасында туризм индустриясының қазіргі заманғы дамуы айтарлықтай белсенді және қарқынды процесс болып табылады, оның басты міндеті туристік бизнестің өңірлік және халықаралық талаптарына сәйкес келетін елдегі туризмді кезең-кезеңімен дамыту және әртүрлі деңгейдегі және бағыттағы туристік қызметтердің барлық спектрін көрсету болып табылады. Мақалада баяндалған зерттеудің мақсаты авторлардың он жылдан астам тәжірибесіне негізделген туристік компанияны жобалаудың заманауи әдістемесін қалыптастыру процесі болды, авторлар ел туризмінің дамуына тікелей әсер ететін негізгі нормативтік-құқықтық және заңнамалық құжаттарды, сондай-ақ елдің жетекші туристік ұйымдарының есептерін зерттеп, талдады. Қызмет көрсету нарығының қазіргі тенденциялары зерттелді. Туризм индустриясы субъектілеріне де, туристік қызметтерді тұтынушыларға да ауқымды сауалнама жүргізілді. Авторлар туристік компанияны құрудың сапалы алгоритмін дайындады, ол 2012 жылдан бастап қазіргі уақытқа дейін туристік бизнесті ашу және табысты басқару саласындағы практикалық қызметтің нәтижесі болды. Мақалада баяндалған осы зерттеулер Қазақстан Республикасында туризмді дамытудың қазіргі кезеңі туралы сапалы түсінік қалыптастырып қана қоймай, сонымен қатар Еуропаның табысты туристік бизнесін құру үшін туристік компанияны ашу алгоритмін пайдалануға мүмкіндік береді.

Түйін сөздер: туризм, туристік компания, туристік бизнес, туристік қызметтер, туризм индустриясы.

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Современная методика проектирования туристской компании в Республике Казахстан

Современное развитие индустрии туризма в Республики Казахстан представляет собой достаточно активный и интенсивный процесс, главной задачей которого является поэтапное развитие туризма в стране, соответствующего региональным и международным требованиям туристского бизнеса и оказания всего спектра туристских услуг разного уровня и направления. Целью исследования, изложенного в статье, стал процесс формирования современной методики проектирования туристской компании, основанной на практическом опыте авторов на протяжении более чем десяти лет, авторами изучены и проанализированы основные нормативно-правовые и законодательные документы, оказывающие прямое влияние на развитие туризма страны, а также отчеты ведущих туристских организаций страны. Исследованы современные тенденции рынка сферы услуг, проведен масштабный опрос как субъектов индустрии туризма, так и самих потребителей туристских услуг. Авторами подготовлен качественный алгоритм создания туристской компании, который стал результатом практической деятельности в области открытия и успешного управления туристского бизнеса с 2012 года и по настоящее время. Данные исследования, изложенные в статье, позволят не только сформировать качественное представление о современном этапе развития туризма в Республике Казахстан, но и дадут возможность использовать алгоритм открытия туристской компании, для построения успешного туристского бизнеса Европы.

Ключевые слова: туризм, туристская компания, туристский бизнес, туристские услуги, индустрия туризма.

Introduction

Legal monitoring of legislative acts in the sphere of tourism activity has shown that the main legislative act regulating the development of tourism activity in Kazakhstan is the Law of the RK "On Tourism Activity in the Republic of Kazakhstan" dated June 13, 2001 № 211 (https://adilet.zan.kz/rus/docs/Z010000211_). For the gradual development of the tourism industry in the country, a number of policy documents and projects related to the creation of priority tourist territories (Petrenko E.S. et al., 2019:2677) and tourist destinations were adopted and specific steps to achieve the goals set by the government were outlined. Thus, the Concepts for the development of the tourism industry of the Republic of Kazakhstan were systematically adopted and implemented, the latter was approved for 2023 – 2029 and came into force on March 28, 2023 No. 262 (https://adilet.zan.kz/rus/docs/P2300000262).

The tourism industry is one of the most promising directions for the development of the economy of the Republic of Kazakhstan. The country has a huge number of objects of historical, cultural and natural heritage and tourism faces the task of their preservation (Aldybayev V. et al., 2021:1450) through the formation of a special structure of promotion and popularization of tourism as a prospective business of the country. To date, it is no longer just a business, it is an activity aimed at promoting tourism in the country in the Republic. The conditions for opening travel agencies and travel companies are being constantly optimized, subsidized and supported by the state.

A study of international scientific papers in the field of tourism business organization has shown the importance of forming global experience in the field of tourism (Mohanty P., 2021:2712). Today, travel agencies need not only to provide high-quality services (Granados, J.C. et al., 2021:27), but also to actively interact with each other. Thus, the experience of Kazakhstan may be of interest to the European tourism business (Moliner M.A. et al., 2007:194), which in turn is a priority for many countries and regions of the world.

The development of the tourism industry in the Republic of Kazakhstan has several key stages of its development, each of which is characterized by a number of peculiarities, and in each period the formation and opening of a travel company had its own distinctive features. Today, the country has a clear course for the development of various types of tourism, for example, Kazakhstan has a great potential (Ayetov S., Uruzbayeva N., 2018:1202) for

the development of ecotourism (Pazylkhaiyr B.M. et al., 2023:83; Sadykova D.A. et al., 2023:84), cultural and educational tourism (Morar C. et al., 2020:1470), active, sports (Makogonov A.N., 2015:193), extreme, business, etc. types, forms and directions of organization of tourist offer for domestic and inbound tourism of the country.

International experts have been repeatedly noting the growth of tourism in Kazakhstan and have characterized its progressive and sustainable development (Mukhanova A.E., Smagulova Zh.B., 2017:176). The tourism potential of Kazakhstan, its tourist and recreational resources (Amirkhanov M.M., Arakelov A.S., 2013:147), are able to meet the needs of the most demanding tourists, while the main tourism product is the hospitality and benevolence of the Kazakh people (Aimen A.T. et al., 2022:49), which are the basis for the organization of tourism business in the country. In the process of the study, the authors analyzed the practical experience of opening travel companies at different stages of professional activity.

Thus, in the country, the following steps have been taken to develop the tourism industry and all its elements:

1. Gradual simplification of procedures for obtaining business licenses and reduction of their issuance time (https://adilet.zan.kz/rus/docs/P1200000929).

2. Creation of specialized business support centers to receive consultations and information on business development opportunities (https://egov.kz/cms/ru/articles/damu).

3. Opening a series of international airlines, increasing the frequency and number of flights, which contributes to the growth of tourist flow (Kosenov A., 2012).

4. Holding a number of large-scale events aimed at attracting investment in the tourism sector, including EXPO-2017 exhibition, sports events of different levels, forums and presentations, scientific congresses and meetings of international level (Kazinform, 2013).

5. Development of the tourism industry infrastructure, including construction of new hotels, restaurants and entertainment centers as well as enhancement of the transport network and tourist routes (https://www.akorda.kz/ru/official_documents/strategies_and_programs).

6. Improvement of the country's image in the world community through advertising campaigns and participation in international exhibitions and forums (https://adilet.zan.kz/rus/docs/Z1400000193).

8. Reduction of bureaucratic procedures and simplification of tax legislation to attract foreign investors.

9. Opening new tourist routes, tourist clusters, tourism development programs to attract domestic and international tourists.

10. Holding local events such as festivals and exhibitions to attract tourists to regions outside the main tourist routes.

11. Strengthening the work on education and training in the tourism sector, including the implementation of specialized training programs.

With the help of government support, a strong tourism business sector is increasingly emerging in Kazakhstan, and travel companies are increasingly implementing tourist offers within different types of tourism, such as ecological tourism (Pazylkhaiyr et al., 2023), sports tourism (Batyrbekov N. et al., 2022:1458), cultural-cognitive and museum tourism (Gubarenko A.V. et al., 2023:20) as well as all types of tourism aimed at popularizing the natural-climatic, cultural and cognitive heritage of the country, and tourism companies working on domestic and inbound tourism are called to give a powerful impetus for the rise of Kazakhstan to a leading position in the development of sustainable tourism (Sumarmi S., et al., 2023:696) in the modern world.

Materials and methods

In the course of the study, the necessary practical experience was accumulated on the organization and reorganization of tourism business of the country, taking into account the distinctive features of each period of tourism development, the availability of basic documents on tourism, the rules of registration of travel companies in accordance with the legislation of the Republic of Kazakhstan.

The research methodology consisted of several cyclical phases where the empirical study was predominant and the phases were interrelated:

Phase 1: Collection and analysis of information on forms and ways of organizing tourism business in the Republic of Kazakhstan, study of the current market, determination of target needs and identification of the direction of work (2011-2012, 2012-2018, 2018-2022).

Phase 2: Opening a travel company, practical research, going through all the processes empirically, identifying the best ways to develop a travel company (2012-2018, 2018 -2023 to date).

Phase 3. Development of a methodology for creating a tourism company in the Republic of Kazakhstan, considering all available experience, preparation and implementation of this methodology in the disciplines «Tour Operating», «Organization of tourism business», «Organization and management of tourism enterprise», etc. in the educational programs on tourism of the leading universities of Kazakhstan.

The practical experience of the authors made it possible to conduct a comparative analysis of algorithms for opening tourism companies for different periods of time, selected basing on the empirical part of the study (the authors have experience in opening tourism companies in the Republic of Kazakhstan in 2012, 2018, 2023), which was conducted to identify qualitative changes in the procedure of registration of a travel company in Kazakhstan in 2012, 2018 and in 2023. As a result, a comparative Table 1 was compiled, which outlines the main standards, forms of registration, required documents, etc.

Therefore, based on Table 1, the process of opening a travel company in 2012 required personal attendance at the Population Service Center, obtaining the originals of the required documents, and the decision was made within three working days. With the introduction of EDS (electronic digital signature) in wide use among the population, as well as the qualitative introduction of «eGov.kz» – the portal of «e-government», the time of registration of a travel company was reduced to 15 minutes, while all digital originals of documents are stored in the «Personal Cabinet» and are always available to the owner. Today it is quite easy to open a travel company, if all the necessary elements are provided, but the formation of an effective development strategy requires continuous professional self-improvement and development.

Table 1 – Comparative analysis of the step-by-step algorithm of opening a travel company in 2012, 2018 and in 2023 (compiled by the authors based on empirical research)

Travel agency incorporation	**2012**	**2018**	**2023**
Optimal incorporation method	Individual Entrepreneur (IE)	Individual Entrepreneur (IE), Limited Liability Partnership (LLP)	IE, LLP
Incorporation period	3 business days	15 minutes	15 minutes
Attendance required	Personal presence at the place-of-residence tax office	Online	Online
Documents required:	1. Application form 2. Photo 3. Incorporation fee payment 4. Taxpayer registration payment 5. ID card 6. Taxpayer registration certificate **Hard copy documents only*	Electronic digital signature (EDS) of the company founder (EDS are issued at the Public Service Centre (PSC)). **Digital documents*	Electronic digital signature (EDS) of the company founder (It is also possible to do a Digital registration via Egovmobile, forgoing the need to issue an EDS) **Digital documents*
Outcome:	Individual Entrepreneur (IE) certificate and IE Coupon issued	Business registration confirmation issued digitally, Business Identification Number (BIN) assigned to the company, IE Coupon or an LLP registration certificate issued digitally	Business registration confirmation issued digitally, Business Identification Number (BIN) assigned to the company, IE Coupon or an LLP registration certificate issued digitally

The experimental part of the research implied the study of the algorithm of formation, organization and development of a travel company from 2012 to the present, the result was the elaboration of the existing experience and methodology of opening a travel company Grand Ways International in 2012 (expanded and reorganized into LLP «Evisa Travel» in 2018 – https://evisa.kz/o-kompanii/ecofrendly/), specializing in the field of exit non-immigrant visas for residents of the Republic of Kazakhstan in the field of tourism, which considered the socio-economic situation, and modern marketing technologies of each time period of tourism development in the Republic of Kazakhstan.

Results and discussion

As a result of their research and professional practice, the authors developed an innovative methodology – an algorithm for creating travel companies in Kazakhstan. This methodology draws upon years of experience with managing travel companies here, making it accessible to current and aspiring entrepreneurs interested in opening travel companies that will operate successfully within Kazakhstan's tourism market.

The algorithm for the formation and development of a travel company includes both main and additional stages (Figure 1) that should be carried out systematically to meet both its own goals as well as those set forth by sustainable tourism development goals (Sovetkali O. et al, 2020:81). Business strategies in tourism play an essential part in attracting investments (Imangozhina O.Z. 2015:758) so tourism becomes an integral component of national revenue streams Figure 1 depicts an ideal process for travel company registration and development within Kazakhstan's tourism market conditions.

The methodology represents an algorithm of actions taken by one specific subject of Kazakhstan's tourism industry that has gone through an intensive process of formation, registration, development, restructuring and ongoing professional improvement since being first registered as part of their tourism business in 2005.

Descriptions of Stages 1-23 in the «Methodology for Establishment of Tourism Business (Travel Company) in Kazakhstan» by its authors:

Stage 1. Select an Organizational and Legal Form.

The Republic of Kazakhstan provides tourism entrepreneurs with various legal structures for doing business in tourism – Joint Stock Companies, Limited Liability Partnerships (LLP), Individual Entrepreneurs (IEs), etc. However, after studying these various forms of entrepreneurship for travel businesses registration as an Individual Entrepreneur was found to be the optimal way of starting up with minimal resource costs incurred; specifically, as registration as an IE does not necessitate creating authorized capital, memoranda of association, accountant presence etc documents needed when setting up travel companies as joint stock companies etc.

Stage 2. Registration of the organization.

Register the organization at the tax office. Secure a Business Identification Number (BIN), place of registration, and gather any required documents (Coupon/IE Certificate). To register an individual entrepreneurship, only the identification documents of physical persons involved and notifying the relevant authority of its registration are required. As part of filling out a registration form, GCEA, or General Classification of Economic Activities will also need to be included as part of this classification system. GCEA is used in Kazakhstan for statistical accounting and analysis of economic activities of enterprises and organizations. GCEA helps classify various activities while creating statistical links among different sectors of the economy. They're also essential in planning economic policy of the state as well as making decisions related to regulation processes – each company can select three to five GCEAs simultaneously (https://statinfo.kz/oked-rk.html).

In 2015, the state registration tax was abolished in the Republic of Kazakhstan.

Individual Entrepreneur (IE) registration was confirmed at the time of residence registration of an individual, when selecting their address as part of registration procedures. A BIN (Business Identification Number), similar to IIN for individual entrepreneurs was then issued alongside an IE coupon with photos and stamp of registration authority. While not technically an "entity", an "IE" nonetheless operates along similar principles (and usually contains their full names).

Stage 3. Registration with statistical authorities.

Individual entrepreneurs in Kazakhstan must register with statistical authorities by law. Registration enables collection and analysis of statistical data on small businesses within Kazakhstan as well as its number, size, dynamics, development. Such information provides data which help the state formulate economic policy as well as monitor implementation of state programs geared at supporting small business growth. Furthermore, registration allows an IE to gather up-to-date market intelligence regarding competitors which could prove valuable when developing its business ventures.

Failure to submit statistical data results in penalties; for this reason, it is recommended to submit it promptly each year – https://egov.kz/cms/ru/articles/statformy_instructions.

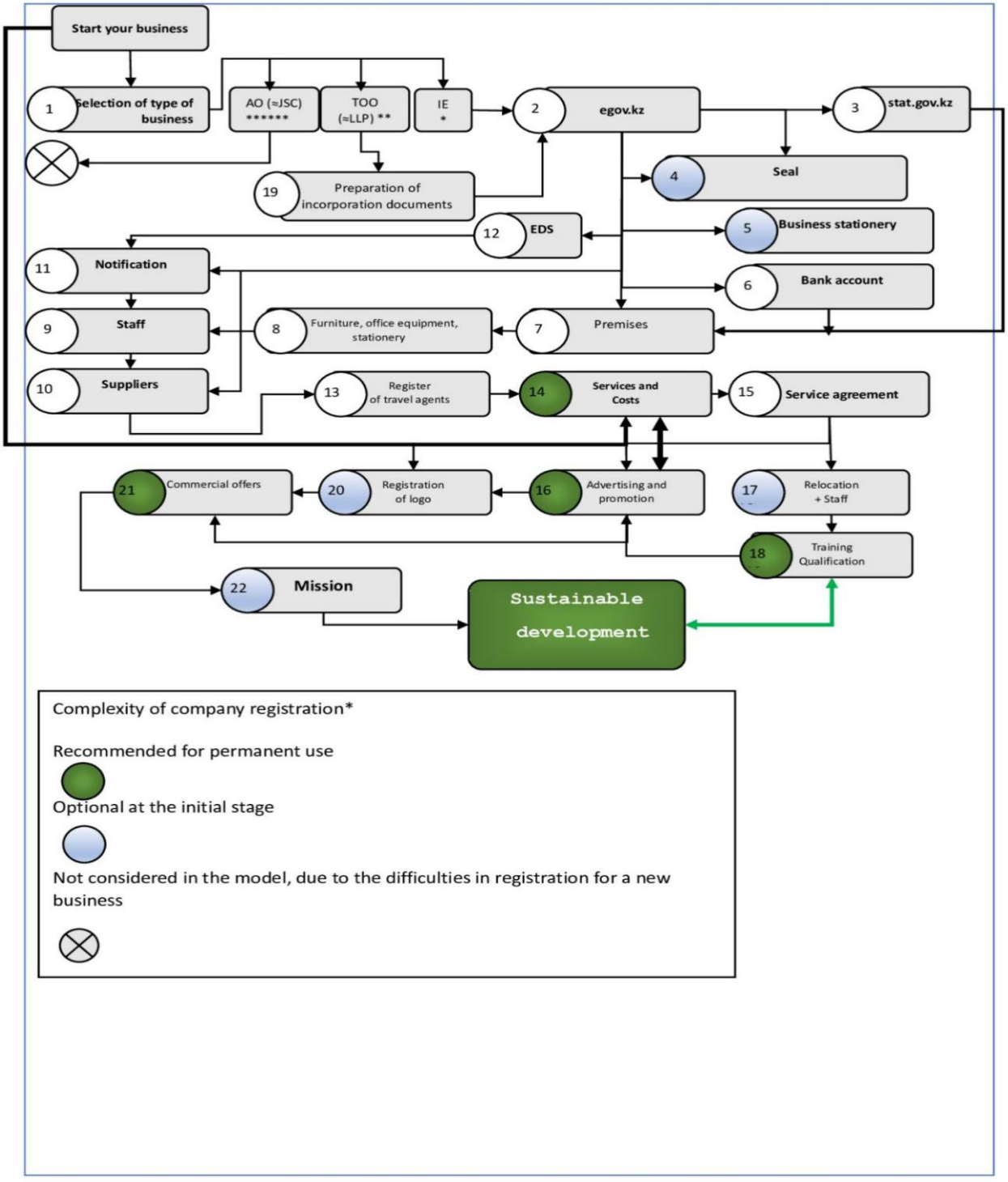

Figure 1 – Algorithm for Establishing a Travel Company in Kazakhstan (compiled by authors)

Stage 4. Formalizing the entrepreneur's stamp.

Under paragraph 4 of Article 33 of the Entrepreneur Code, individual entrepreneurs have the freedom to use personal documentation blanks, seals and stamps that clearly state they are individual entrepreneurs when carrying out their operations. According to paragraph 12 of Article 412 of the Tax Code of the Republic of Kazakhstan (Tax Code),

any invoice issued to an IE may be verified with their stamp if available; if not available, RK law allows an IE to carry on its activities even without a stamp.

Since 2016, businesses operating through an IE without using stamps have been permitted. Instead, an identification tool known as an I.E. Code number serves as an authentication mechanism in legal documents like contracts, licenses, acts agreements and statements as well as cash receipts.

Stage 5. Creation of Business Document Forms.

Entrepreneurs need business documentation forms to streamline the creation and sending of documents quickly and efficiently. Forms ensure consistent styles and layout of documents while eliminating errors that require filling-in of information twice, saving both time and resources while speeding up business operations more rapidly and efficiently. In addition, the use of business documentation forms facilitates interaction with partners, customers, government agencies and other participants in business processes, simplifying document preparation procedures and increasing their reliability.

Stage 6. Opening a company bank account.

For entrepreneurs, a company bank account is essential as it provides the following benefits:

1. Separation of personal and corporate finances.
2. Attracting investment and financing.
3. Simplifying accounting.
4. Securing financial transactions.
5. Convenience for partners.
6. Increases trust to the company and simplifies business processes.

Stage 7. Renting premises to accommodate visitors and future personnel.

After gathering details of your organization, the next step should be renting the premises on a lease agreement with your landlord (or signing one in parallel with steps 1-6). For Grand Ways International's initial leased space consisted of 10 sqm in a business center for 2-3 workplaces located in one of Almaty (Republic of Kazakhstan)'s busiest business districts based on access by own transport as well as public transit for future visitors; visa centers and diplomatic missions of foreign countries in relation to exit documents related to tourism (visas) was also considered.

Stage 8. Acquisition of Office Equipment and Stationery.

To successfully establish a travel agency, acquiring minimum set of office equipment was crucial to ensure proper employee work practices as well as efficient office operation.

Stage 9. Recruitment.

To identify or hire a tourist manager for which first, advertisements were posted in newspapers and employment websites as well as searching among acquaintances, partners and competitors.

1. Establishing the Vacancy.
2. Searching for Candidates.
3. Selection of resumes.
4. Interviewing.
5. Evaluation of candidates.
6. Determination of salary and execution of the contract.
7. Training of new employees. New employees received training from the entrepreneur in the process so that they could get involved to work as quickly and efficiently as possible.

Stage 10. Conclusion of contracts with suppliers. Sub-agent status.

Due to the fact that the initial purpose was defined as services in the field of visas and immigration, contracts with tour operators were necessary only to notify about the beginning of travel agency activities (at the request of the authorized body).

To organize business activities, the travel agency needs to develop standard contracts for their subsequent conclusion with the tour operator, insurance company, courier service, with the GDS Amadeus (Global Distribution System), with the consolidator-supplier of air ticket forms. Besides the main contracts, there are also such contracts as contract for delivery of drinking water to the office, outsourcing contract for accounting and financial reporting, contract for purchase and maintenance of cash registers, contract for use of advertising and promotion platform, contract for maintenance of office equipment etc.

Stage11: Notification of Commencement of Work as Travel Agency.

Kazakhstan does not require special licenses for travel agencies to operate, unlike tour operators' businesses, so all that is necessary to begin travel agency activity is notifying the Ministry of Culture and Sports of the Republic of Kazakhstan (MCS RK) about it. Notification had to be sent on paper to Astana with registration data attached (on letterhead with registration documents attached as evidence) when starting up in 2012. Upon receiving, MCS RK processes it, verifies information, then issues a confirmation letter on strict reporting form with certain numbers that indicate your acceptance into MCS RK as travel agencies.

At this time, notification takes place through the Official Website https://elicense.kz/ by using an

Electronic Digital Signature key and takes no more than five to ten minutes. After which, an electronic confirmation in PDF format of starting travel agency activity is delivered.

Stage 12: Obtaining an Electronic Digital Signature Key in Kazakhstan.

An EDS key (Electronic Digital Signature) in Kazakhstan serves to protect documents against forgery by using cryptography to secure them with its electronic digital signature. Kazakhstan uses electronic document flow systems for various uses, including signing electronic contracts and creating reports and documents electronically; also, other purposes related to document exchange are often involved. Holders of EDS keys ensure authentication, integrity and confidentiality for information exchanged electronically. An electronic digital signature is legally equivalent to handwritten signature and has the same legal consequences if certain conditions are fulfilled in accordance with Kazakhstan Law No. 370-II «On Electronic Document and Electronic Digital Signature».

Both individuals and legal entities can obtain EDS. The National Certification Center of Kazakhstan (NCC) issues EDS to its population. EDSs may be requested online through the NCC of Kazakhstan's website and confirmed at any PSC (Public Service Center).

Stage 13: Registration in the Unified Register of Travel Agencies of Kazakhstan.

In 2012, following the elimination of state licensing of travel agency activities, Kazakhstan Tourism Association (KTA) created the Unified Register of Travel Agencies of the Republic of Kazakhstan (URT RK). Unique in its kind, the Unified Register of Travel Agents in Kazakhstan is an electronic database containing details on both companies and individual entrepreneurs engaged in tourism activities in accordance with Kazakhstan's Law on Tourism (Legum Tourismi). Operating under principles of voluntarism and transparency, URT RK compiles information about many players of Kazakhstan tourism market and makes this information easily available for tour operators, tourists and other interested parties.

It is important to note that since 2015, all travel agencies registered in the URT RK have become associate members of the KTA, which emphasizes their importance in the Kazakhstan tourism market.

Stage 14: Defining the range and cost of services.

The services offered in this company were defined as follows:

1. The experience of the entrepreneur in providing certain services. Previous experience in the travel agency gave the opportunity to emphasize mainly on visa services without purchasing tour packages for tourists. This made it possible to attract clients interested in independent travel, businessmen, athletes and students. Hence the target audience of the company was determined.

2. Availability of contracts with tour operators. Each tour operator offers a certain tour package and flight destinations may not be in large numbers (for example, only Turkey, UAE, Egypt). Therefore, part of the services in the sale of tour packages was limited to those that were available at the tour operator. Thus, the more contracts with different suppliers a company has, the more types of services and packages it can offer. However, this approach does not allow to enrich professionalism in a particular destination but allows to have superficial general knowledge of many other destinations.

3. Some of the service offerings were created in the process of demand from visitors. If tourists often began to request a particular destination or visa support to a particular country – the travel agency began to study the destination in the process of the order from the tourist (by experience), taking all the risks in case of failure (in case of refusal in visa through the fault of the executor, for example, that is the travel agency, the cost of services was returned in full, including all the costs incurred by the tourist). Or the cost of services was paid upon receiving a positive result. This format of work allowed to quickly attract tourists, who would not lose anything in case of unsatisfactory results. And it allowed to quickly get and increase the experience of managers of the company. If the service was labor-intensive, the price for subsequent orders varied depending on the complexity and duration of the process.

4. The focus on the business office located in the business district of the city, also allowed to attract employees of neighboring offices of companies interested in services, travel, tickets and visas, which additionally created a target audience in the form of business travelers (MICE tourism)

5. Increased tourism services demand has also spurred exploration in uncharted directions, such as immigration abroad, residency permit acquisition, work visa issuance for Kazakhstan and employment abroad.

6. Being bilingual in Russian and Kazakh enabled more effective population services; English proficiency contributed greatly to improving American, British and Canadian visa applications; these

results served as "word of mouth", with most tourists opting to apply based on recommendations of acquaintances.

Stage 15. Drafting a Service Contract.

In travel agencies, service contracts between tourists and travel agents are one of the key documents which outline rights and responsibilities between both parties involved in their relationship. They serve multiple purposes and have numerous objectives, including providing for payment obligations by each side and outlining obligations between tourists and agents for instance.

1. To outline clearly and precisely the conditions of their stay in their country of choice.

2. Ensuring Tourist Safety.

3. Clarifying Responsibilities.

4. Addressing Financial Matters.

5. This document clearly establishes who is accountable for visa processing.

6. A contract defines the roles and responsibilities of both parties involved.

7. The contract protects the interests of both parties in case of violation of deadlines, non-compliance with the rules of execution of documents, etc.

8. In the presence of the contract, the tourist can appeal to the court in case of inefficiency of the services received.

Thus, a service contract with a tourist helps to prevent possible conflicts between the parties and protects the rights and interests of tourists/tour agents. A model contract for services can be downloaded from the KTA website (Kaztour-association, 2024).

Stage 16. Advertising and promotion.

Launching an advertising campaign is one of the most important steps to attract customers to the travel agency. The most economical and effective way was online advertising. One can use social media marketing, contextual advertising, email newsletters, blog postings, message boards, travel forums, etc.

The first advertising of the company "Grand Ways International" was done by emailing companies from the city directory and was free of charge. The entrepreneur independently studied the directory, wrote out email addresses and sent mailings from his own mailing address. Out of 500 mails sent, 1-2 customers responded. The purpose of the e-mail newsletters was to inform future customers about the company's services and costs. The conversion rate from the first e-mail newsletter was low, but sufficient for a start. About 500 mailings were sent per week.

The second way was to post information on free internet bulletin boards, posting information about the company, address, services and cost. The freshness of announcements was constantly updated.

Creation of the company's website was carried out through the satu.kz platform with a convenient interface, it was enough to upload information about the company, fill in the catalog of services, give additional information and photos of travel.

The most effective advertising in Google (analytics and promotion tools are available and understandable to any user, as well as there is educational content), both paid and free (in the form of SEO optimization of the site). It is worth noting that advertising by any means did not stop, daily, weekly information was updated, either on websites or social networks. Nowadays it is recommended to hire several employees such as a marketer, SSM specialist, new customer acquisition manager, etc. Additionally, travel managers should be trained to advertise themselves as part of the brand, share success stories on social media, improve and add to their experience and knowledge constantly.

Stage 17. Relocation, Staff Augmentation and Quality Service Improvement.

By the end of 2012, clients and services had become so inundated with client demand that the entrepreneur decided to rent an office space four times larger than his original one. This led to a reorganization of services, office and team employees as well as expanding airfare selection and travel expansion offerings; the size of the office, the location in the city, having parking available at the premises, as well as being located right next to other large companies on adjacent floors were the things that added gravitas to the company image.

Stage 18. Staff training and corporate spirit building.

Employee training keeps them abreast of industry changes and trends while developing their knowledge and abilities – essential factors in providing better services that enhance customer loyalty and create more profit for your agency.

Raising corporate spirit fosters improved cooperation and teamwork between employees in your company. Employees will come to better understand your goals and objectives and work in unison towards reaching them.

The stages, shown above, are the result of the experimental and professional work on the process of opening of «Evisa Travel» LLP. The company followed the procedure "Stage 2 – Stage 18" in the same sequence, and the site was immediately pur-

chased from the developers, which could be modified and redesigned its content and design, as well as upload payment platforms (CSCart).

Stage 19: Opening of «Evisa Travel» LLP as a company reorganization.

Reorganizing an individual entrepreneur (IE) into a limited liability partnership (LLP) can open up numerous business opportunities and improve creditworthiness, legal status and prestige on the market. An LLP is its own legal entity with its own legal status that gives it rights to conclude transactions and appear in court proceedings; using this form of business will help avoid personal liability for company debts as well as certain tax and administrative restrictions that exist for individual entrepreneurs.

Reorganization also provides additional opportunities for attracting investment, obtaining loans and increasing working capital. Also, if the volume of business increases, the LLP has more opportunities to expand its network of branches and offices. In general, reorganization of a sole proprietor into an LLP can be one of the key steps in developing and expanding the business, conducting more productive and safe operations, attracting new clients and improving the financial position of the company.

The next step the entrepreneur reorganized the IE into an LLP, as the company's turnover increased, the degree of liability to tourists began to grow, and the IE should be liable in case of financial debt with all its property (the entrepreneur's apartment, car, etc.) to creditors.

When analyzing the organization of IE and LLP, the entrepreneur concluded not to close the IE, but to open an additional LLP, where his main business activities were transferred.

Stage 20. Creating a logo and registering the intellectual property of the travel agency is necessary to define the corporate identity and ensure legal protection of the brand.

Registration of intellectual property of a travel agency includes applying for trademark registration of the logo and obtaining the relevant certificate. This officially protects the brand and logo from possible infringement and copying by other companies, and also grants the right to use the mark for commercial purposes.

«Evisa Travel» registered their logo with NIIS (the National Institute of Intellectual Property upon their opening.

Stage 21. To increase visibility of visa and travel document services provided by travel agencies in Kazakhstan and gain new clients. A commercial proposal of such agencies presents their offerings and convinces potential clients of their importance.

The developing a commercial proposal allowed the travel agency to attract new clients, enhance its reputation, and effectively market its services.

Stage 22. Formulate Company Mission and HR Policy.

Mission-driven companies tend to combine the meaning of what they want to achieve through their activities with attributes and outcomes for a unified mission statement.

Writing a mission for any travel agency helps establish its goals and direction of activity, establish work principles, develop a development strategy, create a unique identification image and to stand out among competitors. A mission statement serves both internally and for client evaluation. Since «Evisa Travel» LLP's opening in 2018, their company has had one:

«Our mission is to improve people's lives by sharing not only information but also our years of knowledge and experience in tourism and immigration. Our primary goal is providing friendly service that exceeds customer expectations»

Determining the mission of your company is an integral component of its development; yet it can be challenging at first to identify an ideal mission statement immediately upon creation of a new venture. However, with experience comes growth; errors become lessons learnt while successes lead to ups and downs before eventually the team develops one with which they all resonate – creating the ideal mission statement that resonates with everyone involved – including entrepreneurs themselves as well as team members and travelers alike.

An HR policy of any company is an essential tool in its human resource management (Pestova A. et al., 2021:1005) and has an immense effect on business processes. The purpose of an HR policy should be:

1.Recruiting Qualified Professionals.

2.Employee Development and Training.

3. Personnel motivation.

4. Formation of corporate culture.

5. Provision of social and protective measures.

6. In general, the HR policy of the travel agency helps to attract and retain qualified personnel, provides them with conditions for professional growth and improvement of the quality of work, creates favorable conditions for work and increase the economic efficiency of business processes.

Stage 23. Transition to sustainable development. Sustainable development involves imple-

menting business practices that promote respect for the environment and concern for the well-being of the community. This means that a travel company must work with environmental, social and economic factors in mind when making decisions and planning its activities.

Why is this necessary? Firstly, sustainability is a responsible approach to business that allows the tourism industry to remain efficient and prosper on a long-term basis, without harming the environment and considering social well-being. Secondly, sustainability in travel activities helps a travel company to reach a new level of development, improve its image and achieve success in a competitive market.

Based on the algorithm above, that consists of 23 stages, the 3rd tourism company «Go2.kz» LLP was also opened to continue business development. Thus, this algorithm – a step-by-step methodology of organizing a travel company and its reorganization, in the conditions of the tourism market of the Republic of Kazakhstan allows to systematically carry out activities to form a competitive travel company, as well as to be actively implemented in the educational process of higher educational institutions that prepare specialists for the tourism industry and have such courses of disciplines such as «Tour Operating», «Business Planning», «Tourism Business Management» and others, aimed at the formation of sustainable tourism business.

Conclusions

This methodology, developed by the authors in the process of long-term research, allows to integrate the maximum amount of data into a single methodology, algorithm of actions, systematic implementation of which allows future and current subjects of the tourism industry to start, implement or promote their business activities. Thus, this scientific research allows to optimize the activities of modern subjects of the tourism industry providing tourist services in the Republic of Kazakhstan, as well as to form the following conclusions:

- The development of the tourism industry in the Republic of Kazakhstan, throughout the period of independence, has undergone many qualitative changes, which systematically allowed to create a strong base for the formation of competitive business. Every year, the country conducts research in the field of tourism, subsidizes the tourism business, organizes measures to promote small and medium-sized businesses, and the state maximally supports entrepreneurs through basic, regulatory and legislative documents. Today, an important aspect in the activities of travel companies is the step-by-step simplification of the process of registration of travel company.

- Organization of tourism business in the Republic of Kazakhstan, at different stages of tourism development in the state, was a multifaceted, and at the first stages a rather complex process, which was quickly enough automated and effectively simplified, as well as adapted to the needs of potential and real subjects of the tourism industry.

- Creation of a methodology, algorithm of development of a travel company in the conditions of the tourist market of the Republic of Kazakhstan, was the result of a long process of professional activity in the field of creation and management of a travel company, as well as in the training of tourist personnel. This methodology is able to have a qualitative impact on the process of opening a travel company, as it is a real study of empirical level, integrated into practice and implemented in educational programs for training of tourism personnel in the Republic of Kazakhstan.

Thus, the creation of a modern methodology for designing a travel company in the Republic of Kazakhstan was an organic conclusion of the empirical research, which continues at present.

Modern tourism industry in the Republic of Kazakhstan involves continuous improvement and development, which is impossible without two components: the first is the support of the state, expressed in the development of tourism development programs of the country, subsidizing small and medium-sized businesses, simplifying the process of registration and employment of travel companies, the second is an active position of potential and existing subjects of the tourism industry in the process of formation and development of travel companies. Thus, the developed methodology for the creation of travel companies can have a qualitative impact on the development of tourism in the country, through the systematization of this process for both the business environment and the educational process in the direction of tourism.

References

Aimen, A.T., Faizova, E.R., Jolanov, E.E., Dossymova, O.Zh. (2022). Analysis of the prospects for the development of extreme tourism in the Republic of Kazakhstan. Tourism and Hospitality, № 1, 49-54

Aldybayev, V., Gubarenko, A., Imangulova, T., Ussubaliyeva, S., Abdikarimova, M. (2021) Popularizatin of objects of the cultural and historical Heritage of the republic of Kazakhstan as a factor for the development of ethnocultural tourism of the country. GeoJournal of Tourism and Geosites, 39(4spl), 1450–1460. doi: 10.30892/gtg.394spl16-789

Amirkhanov, M.M., Arakelov, A.S. (2013). Teoreticheskie i metodicheskie aspekty ocenki turistsko-rekreacionnogo potenciala regionov s rekreacionnoj specializaciej [Theoretical and methodological aspects of assessing the tourist and recreational potential of regions with recreational specialization]. Sovremennaya nauchnaya mysl'. 2, 147-154, (in Russian).

Ayetov, S., Uruzbayeva, N. (2018). Current Issues of Inbound Tourism in the Republic of Kazakhstan and Ways of Promotion. Journal of Environmental Management and Tourism, (Volume IX, Fall), 6(30), 1202-1209. doi: 10.14505//jemt.v9.6(30).06

Batyrbekov, N., Imangulova, T., Gubarenko, A., Abdikarimova, M., Yessimova, D. (2022). Promising directions for the development of sports tourism in the Almaty region using the example of rock climbing. GeoJournal of Tourism and Geosites, 44(4), 1418–1426. doi: 10.30892/gtg.44429-961

Gubarenko A.V., Abdikarimova M.N., Pestova A.A. (2023). Development of museum tourism in Kazakhstan in the training of tourist personnel. Theory and methodology of physical culture, 2 (72), 20-31.

Granados, J.C., Pérez, L.M., Pedraza-Rodríguez, J.A., Gallarza, M.(2021). Revisiting the quality-value-satisfaction-loyalty chain for corporate customers in the travel agency sector. European Journal of Tourism Research, 27, 2711.

Imangozhina, O.Z. (2015). The concept of using information technology in the development of the financial system and tourism // International Journal of Applied and Fundamental Research, 12-5, 785–788 (In Russian)

Kazinform (2013). Astana's first presentation as a winning city of EXPO-2017 took place in Paris [Electronic resource]. Official website of the Inform.kz. URL: https://www.inform.kz/ru/v-parizhe-za-chas-do-golosovaniya-proshla-zaklyuchitel-naya-prezentaciya-astany-na-provedenie-expo-2017-video_a2512514

Kaztour-association (2024). Samples of civil-law contracts [Electronic resource]. Official website of the Kaztour-association. URL: https://kaztour-association.com/yuridicheskaya-informaciya/obrazcy-dogovorov-gpo/

Kosenov, A. (2012). Eight New International Air Routes to Open in Kazakhstan in 2012 [Electronic resource]. Online Media Tengrinews. URL: https://tengrinews.kz/kazakhstan_news/vosem-novyih-mejdunarodnyih-aviamarshrutov-otkroyutsya-212109/

Makogonov, A.N. (2015). Aktivnye vidy turizma [Active types of tourism]. Almaty, KazAST, 193 p. (In Russian)

Mohanty, P. (2021). Book Review of Dixit, S.K.(Ed.) (2020) The Routledge Handbook of Tourism Experience Management and Marketing. Oxon: Routledge. European Journal of Tourism Research, 27, 2712.

Moliner, M.A., Sánchez, J., Rodríguez, R.M., Callarisa, L. (2007). Relationship quality with a travel agency: The influence of the postpurchase perceived value of a tourism package. Tourism and Hospitality Research, 7(3/4), 194–211.

Morar, C., Grama, V., Stupariu, I.M., Nagy, G., Boros, L., Tiba, Al., Gozner, M., Szabo-Alexi, S. (2020). Local perspectives over cultural tourism to heritage sites. The case study of Oradea fortress (Romania). GeoJournal of Tourism and Geosites, 33(4spl), 1470–1479. doi: 10.30892/gtg.334spl04-595

Mukhanova, A.E., Smagulova, Zh.B. (2017). Analysis of tourism development in the Republic of Kazakhstan. In the collection: Current issues in economic sciences. Collection of materials of the LVIII International Scientific and Practical Conference, 176-180. (In Russian)

Pazylkhaiyr, B.M., Assipova, Zh.M., Aktymbayeva, A.S. (2023). Research in eco-tourism in Kazakhstan as a successful mechanism in the development of environmental tourism management. Central Asian Economic Review, 1 (148), 83-97.

Pestova, A., Gubarenko, A., Imangulova, T., Ussubaliyeva, S., & Uaisova, A. (2021). Conceptual framework of human resource management in tourism education of the Republic of Kazakhstan. GeoJournal of Tourism and Geosites, 38(4), 1005–1010. doi: 10.30892/gtg.38403-73

Petrenko, E.S., Dauletova, A.M., Mazhitova, S.K., Shabaltina, L.V. (2019) Analysis of government support measures for tourism development in the Republic of Kazakhstan. Economic relations, 9(4), 2677-2692. doi: 10.18334/eo.9.4.41427 (In Russian)

Sadykova, D.A., Kenzhebay, R.N., Kozhabekova, Z.E., Saulembaev, A.T., Kubesova G.T., Ospanbaeva A.A. (2023). Development of ecotourism in the mountainous regions of Kazakhstan. Astrakhan Bulletin of Environmental Education, 1 (73), 94-105 (In Russian)

Sovetkali, O.S.U., Mametova, N.B., Seidualin, D.A. (2020). Prospects for the development of small businesses in the field of tourism in the Republic of Kazakhstan. In the collection: Integration of tourism into the economic system of the region: prospects and barriers. Materials of the II International Scientific and Practical Conference. Orel, pp. 81-86. (In Russian)

Sumarmi, S., Sholeha, A.W., Kurniawati, E., Hakiki, A.R., Hidiyah, T.M. (2023). Development strategy for special interest tourism (sit) through community-based ecotourism (cbet) in Perawan Beach To Promote A Sustainable Economy. GeoJournal of Tourism and Geosites, 48(2spl), 696–708. doi: 10.30892/gtg.482spl03-1069

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Бірінші бет:

Бірінші жол – ҒТАМР нөмірі (ерекше жағдайда ӘОЖ), мәтін беттің сол жақ шетімен тегістеледі, қаралау шрифт.

Мақала атауы (Тақырып) мақаланың мәні мен мазмұнын көрсетіп, оқырманның назарын аудару керек. Тақырып қысқа әрі ақпараттық, жаргондар мен Название должно быть кратким, информативным и не содержать жаргонизмов или аббревиатурасыз жазылуы тиіс. Тақырыптың орташа ұзындығы 5-7 сөз (кей жағдайда 10-12 сөз). Мақаланың тақырыбы қазақ, орыс және ағылшын тілдерінде берілуі керек. Тақырып қаралау шрифтті кіші әріптермен, беттің ортасымен тегістеледі.

Мақала автор(лар)ы – аты-жөнінің бірінші әріптері және тегі, жұмыс істейтін орны (аффилиация), қала, мемлекет, email – орыс, қазақ және ағылшын тілдерінде жазылады. Авторлар туралы ақпарат қалыпты шрифтті кіші әріптермен жазылып, беттің ортасында тегістеледі.

Аңдатпа көлемі 150-300 сөз қазақ, орыс, ағылшын тілдерінде жазылады.

Аңдатпа құрылымында келесі ақпарат міндетті түрде болуы керек:

- Зерттеу тақырыбы бойынша кіріспе сөз.
- Ғылыми зерттеудің мақсаты, негізгі бағыттары мен идеялары.
- Жұмыстың ғылыми және практикалық маңыздылығы бойынша қысқа ақпарат.
- Зерттеу әдістемесі бойынша қысқа ақпарат.
- Ғылыми зерттеудің негізгі нәтижелері, талдау және тұжырымдама.
- Жүргізілген зерттеу жұмысының маңыздылығы (аталған жұмыстың ғылымның сәйкес саласына енгізген үлесі)
- Жұмыс қорытындысының практикалық маңыздылығы.
- Кілт сөздер/сөз тіркестері – орыс, қазақ, ағылшын тілдерінде 3-5 сөз аралығында.

Келесі бет (жаңа бет):

Кіріспе келесіде берілген негізгі элементтерден тұрады:

Таңдалған тақырыптың негіздемесі; тақырып өзектілігі мен зерттеу проблемалары. Таңдалған тақырыптың негіздемесінде алдыңғы зерттеушілердің тәжірибелері негізінде проблемалық жағдайдың (зерттеу жұмыстарының жоқтығы, жаңа зерттеу нысанының пайда болғаны және т.б.). бар екендігі айтылады. Тақырыптың өзектілігі аталған зерттеу нысанының қойылған сұрақтарға толық жауаптардың болмаған жағдайда, тақырыптың теориялық және практикалық маңыздылығы арқылы дәлелденіп жалпыға ортақ мүдде арқылы анықталады.

Жұмыстың нысанын, пәнін, мақсаттарын, міндеттерін, тәсілдерін, әдістер, гипотезасын анықтау. Зерттеудің мақсаты тезисті дәлелдеумен, яғни зерттеу тақырыбын автор таңдаған аспектімен көрсетумен байланысты.

Материал мен әдістер - материалдар мен жұмыс барысының сипаттамасынан, сондай-ақ қолданылатын әдістердің толық сипаттамасынан тұруы керек

Зерттеу материалының сипаттамасы оның сапалық және сандық көрінісін қамтиды. Материалдың сипаттамасы - тұжырымдар мен зерттеу әдістерінің сенімділігін анықтайтын факторлардың бірі.

Бұл бөлімде проблеманың қалай зерттелгені сипатталады: бұрын жарияланған рәсімдеулерді қайталамай егжей-тегжейлер ақпарат беріледі; материалдар мен әдістерді қолдану кезінде міндетті түрде енгізілген жаңалықтар арқылы жабдықты сәйкестендіруді (бағдарламалық жасақтама) және материалдардың сипаттамасы қолданылады.

Ғылыми әдістеме келесілерден тұруы қажет:

- зерттеу сұрақтар(ы);
- алға қойлыға гипотеза (тезис);
- зерттеу кезеңдері;

- зерттеу әдістері;
- зерттеу нәтижелері.

Әдебиеттерге шолу жасау бөлімінде - зерттеу тақырыбы бойынша ағылшын тілінде шетелдік авторлардың іргелі және жаңа еңбектер (кемінде 15 жұмыс), оларды ғылыми үлесі түрғысынан талдау, сондай-ақ сіздің мақалаңызда толықтырылған зерттеу кемшіліктері беріледі.

Жұмысқа қатысы жоқ көптеген сілтемелердің болуы немесе сіздің жетістіктеріңіз туралы, алдыңғы жұмыстарыңызды көрсететін сілтемелерді қосуға болмайды.

Нәтижелер мен Талқылау бөлімінде сіздің зерттеу нәтижелеріңізді талдауы және талқылауы беріледі. Зерттеу барысында алынған нәтижелер туралы қорытынды беру арқылы негізгі мәні айқындалады. Бұл мақаланың маңызды бөлімдерінің бірі болып саналады. Онда жұмысыңыздың нәтижелерінің талдауы және алдыңғы жұмыстармен, талдаулармен және тұжырымдамаларымен салыстыру арқылы сәйкес нәтижелерді талқылау беріледі.

Қорытынды, тұжырымдама – жұмыстың осы кезеңдегі нәтижелерін жалпылау және қорытындылау; автор алға қойған тұжырымның растығын және алынған нәтижелерді ескере отырып, ғылыми білімнің өзгеруі туралы автордың қорытындысын растау. Қорытынды абстрактілі болмауы керек, оларды ұсыныстарды немесе одан әрі жасалатын жұмысты сипаттай отырып белгілі бір ғылыми саладағы зерттеу нәтижелерін жалпылау үшін қолдану керек.

Қорытындының құрылымында келесі сұрақтар болуы керек: Зерттеудің мақсаттары мен әдістері қандай? Нәтижелері қандай? Қандай тұжырымдар бар? Зерттемені енгізу, қолдану перспективалары мен мүмкіндіктері қандай?

Пайдаланылған әдебиеттер тізімі немесе библиографиялық тізім жаратылыстану және техникалық бағыттарға кем дегенде 10 атаулардан және әлеуметтік және гуманитарлық бағыттарға 15 атаулардан тұрады, ал ағылшын тіліндегі жалпы атаулар саны 50% -дан кем болмауы керек. Егер сілтемелер тізімінде кириллицада берілген еңбектер болса, сілтемелер тізімін екі нұсқада ұсыну қажет: біріншісі - түпнұсқада, екіншісі - романизацияланған алфавитте (транслитерация).

Романизацияланған әдебиеттер тізімі келесідей болуы керек: автор (лар) (транслитерация - http://www.translit.ru) → (жақшадағы жыл) → транслитерацияланған нұсқадағы мақала тақырыбы [мақала тақырыбының ағылшын тіліндегі аудармасы төрт бұрышты жақшада], орыс тіліндегі дереккөздің атауы (транслитерация немесе бар болған жағдайда ағылшын тілінде), шығыс деректер ағылшын тілінде белгілеулер арқылы жазылады.

Мысалы: Gokhberg L., Kuznetsova T. (2011) Strategiya-2020: novye kontury rossiiskoi innovatsionnoi politiki [Strategy 2020: New Outlines of Innovation Policy]. *Foresight-Russia,* vol. 5, no 4, pp. 8–30. Пайдаланылған әдебиеттер тізімі алфавиттік тәртіпте және тек мәтінге сілтеме жасалған жұмыстар ҒАНА жазылады.

Орыс және қазақ тілдеріндегі әдебиеттер тізімінің стилі ГОСТ 1-2003 “Библиографиялық жазба. Библиографиялық сипаттама. Жалпы талаптар және құрастыру ережелері” сәйкес жасалады.

Әлеуметтік және гуманитарлық бағытта романизацияланған әдебиеттер тізімін, ағылшын тіліндегі (басқа шет тіліндегі) дереккөздер рәсімдеу стилі - American Psychological Association (http://www.apastyle.org/), жаратылыстану және техникалық бағытқа – Chicago Style (www.chicagomanualofstyle.org).

Мысалы:

Кітап:

1. Zadie Smith, Swing Time (New York: Penguin Press, 2016), 315–16.
2. Brian Grazer and Charles Fishman, A Curious Mind: The Secret to a Bigger Life (New York: Simon & Schuster, 2015), 12.

Журнал мақаласы

1. Susan Satterfield, “Livy and the Pax Deum,” Classical Philology 111, no. 2 (April 2016): 170.
2. Shao-Hsun Keng, Chun-Hung Lin, and Peter F. Orazem, “Expanding College Access in Taiwan, 1978–2014: Effects on Graduate Quality and Income Inequality,” Journal of Human Capital 11, no. 1 (Spring 2017): 9–10, https://doi.org/10.1086/690235.
3. Peter LaSalle, “Conundrum: A Story about Reading,” New England Review38, no. 1 (2017): 95, Project MUSE.

Website материалы

1. “Privacy Policy,” Privacy & Terms, Google, last modified April 17, 2017, https://www.google.com/policies/privacy/.
2. “About Yale: Yale Facts,” Yale University, accessed May 1, 2017, https://www.yale.edu/about-yale/yale-facts.
3. Katie Bouman, “How to Take a Picture of a Black Hole,” filmed November 2016 at TEDxBeaconStreet, Brookline, MA, video, 12:51, https://www.ted.com/talks/katie_bouman_what_does_a_black_hole_look_like

Берілген бөлімде төмендегілерді ескеру қажет:

- Ғылымның осы саласында қолданылатын және автордың жұмысы негізделген ғылыми басылымдар, алдыңғы қатарлы зерттеу әдістерінен дәйексөздер келтіріледі.
- Өзіңіздің жұмысыңыздан дәйексөздерді келтіруді шамадан тыс қолданудан аулақ болыңыз.
- Сілтемелерді ТМД / КСРО авторларының басылымдарына шамадан тыс келтіруден аулақ болыңыз, әлемдік тәжірибені қолданыңыз.
- Библиографиялық тізімде мақала тақырыбы бойынша белгілі шетелдік авторлар мен зерттеушілер шығарған іргелі және ең маңызды жұмыстар болуы керек.

Әлеуметтік және гуманитарлы бағыттағы мәтіндерде дәйексөз келтірілген сілтемелер жұмыстың бірінші авторы, шыққан жылы: бет нөмір(лер)і жақша ішінде көрсетіліп беріледі. Мысалы, (Залесский 1991: 25). Әдебиеттер тізімінде бір автордың бір жылда жарық көрген бірнеше жұмысы келтірілген жағдайда, шыққан жылдың түсына «а», «б» және т.б. әріптерді қосып жазу керек. Мысалы, (Садуова, 2001а: 15), (Садуова, 2001б, 22). Жаратылыстану бағытындағы мақалаларда сілтемелер сілтеме жасалған жұмыстардың мақала мәтінінде кездесетін кезеңіне байланысты нөмірленіп тік жақшада беріледі.

Информация для авторов

Публикация материалов в «Вестнике КазНУ. Серии географической» осуществляется с использованием Open Journal System, системы онлайн-подачи и экспертной оценки. Регистрация и авторизация доступны в разделе Отправка материалов.

Автор для корреспонденции обязан предоставить сопроводительное письмо на публикацию в журнале.

Требования к оформлению статьи:

Редакционная коллегия принимает ранее неопубликованные статьи по научным направлениям журнала. Статья представляется в электронном формате (в форматах .doc, .docx, .rtf) ТОЛЬКО посредством ее загрузки через функционал сайта журнала (Open Journal System).

Кегль шрифта – 12 (аннотация, ключевые слова, литература - 10, текст таблиц – 9-11), шрифт – Times New Roman, выравнивание – по ширине текста, интервал – одинарный, абзацный отступ – 0,8 см, поля: верхнее и нижнее – 2 см, левое и правое – 2 см.

Рисунки, таблицы, графики, диаграммы и др. представляются непосредственно в тексте с указанием нумерации и заглавия (Например, Рис. 1 – Название рисунка). Количество рисунков, таблиц, графиков и диаграмм не должно превышать 20% от всего объема статьи (в некоторых случаях до 30%).

Объем статьи (без учета названия, сведений об авторах, аннотации, ключевых слов, библиографического списка) должен составлять не менее 3 000 слов и не превышать 7 000 слов для социогуманитарных направлений, и 1 500-7 000 слов для естественнонаучных и технических направлений.

Авторы в обязательном порядке должны указать в сопроводительном письме в системе Open Journal System или Editorial Manager о том, что направляемая статья/рукопись нигде ранее не публиковалась, и что в статье отсутствуют заимствованные фрагменты текста из других работ без ссылок на них.

СТРУКТУРА СТАТЬИ:

Первая страница:

Первая строка – МРНТИ (Рубрикатор есть в открытом доступе онлайн http://grnti.ru/ или, авторы так же могут получить Код МРНТИ в библиотеке), выравнивание – по левому краю, шрифт – полужирный.

Название статьи (Заголовок) должно отражать суть и содержание статьи и привлекать внимание читателя. Название должно быть кратким, информативным и не содержать жаргонизмов или аббревиатур. Оптимальная длина заголовка – 5-7 слов (в некоторых случаях 10-12 слов). Название статьи должно быть представлено на русском, казахском и английском языках. Название статьи представляется полужирным шрифтом строчными буквами, выравнивание – по центру.

Автор(ы) статьи – с указанием имени и фамилии, ученой степени, ученого звания, занимаемой должности, места работы, город, страна, контактный телефон, email. Сведения об авторах представляются обычным шрифтом строчными буквами, выравнивание – по центру.

Аннотация объемом 150-300 слов на русском, казахском и английском языках.

Структура аннотации включает в себя следующие обязательные пункты:

- Вступительное слово о теме исследования.
- Цель, основные направления и идеи научного исследования.
- Краткое описание научной и практической значимости работы.
- Краткое описание методологии исследования.
- Основные результаты и анализ, выводы исследовательской работы.
- Ценность проведенного исследования (внесенный вклад данной работы в соответствующую область знаний).
- Практическое значение итогов работы.
- Ключевые слова/словосочетания – количеством 3-5 на русском, казахском и английском языках.

Данные в начале статьи (название, авторы, абстрак, ключевые слова) даются на языке оригинала. Далее следует та же информация (без МРНТИ) на английском языке. Потом на казахском или русском (зависит от языка основной статьи).

Последующая страница (новая):

Введение состоит из следующих основных элементов:

Обоснование выбора темы; актуальность темы или проблемы. В обосновании выбора темы на основе описания опыта предшественников сообщается о наличии проблемной ситуации (отсутствие каких-либо исследований, появление нового объекта и т.д.). Актуальность темы определяется общим интересом к изученности данного объекта, но отсутствием исчерпывающих ответов на имеющиеся вопросы, она доказывается теоретической или практической значимостью темы.

Определение объекта, предмета, целей, задач, методов, подходов, гипотезы и значения вашей работы. Цель исследования связана с доказательством тезиса, то есть представлением предмета исследования в избранном автором аспекте.

Материал и Методы – должны состоять из описания материалов и хода работы, а также полного описания использованных методов.

Характеристика или описание материала исследования включает его представление в качественном и количественном отношении. Характеристика материала – один из факторов, определяющий достоверность выводов и методов исследования.

В этом разделе описывается, как проблема была изучена: подробная информация без повторения ранее опубликованных установленных процедур; используется идентификация оборудования (программного обеспечения) и описание материалов, с обязательным внесением новизны при использовании материалов и методов.

Научная методология должна включать в себя:

- исследовательский вопрос(-ы);
- выдвигаемую гипотезу (тезис);

- этапы исследования;
- методы исследования;
- результаты исследования.

В секции обзор литературы – должны быть охвачены фундаментальные и новые труды по исследуемой тематике зарубежных авторов на английском языке (не менее 15 трудов), анализ данных трудов с точки зрения их научного вклада, а также пробелы в исследовании, которые Вы дополняете в своей статье.

Недопустимо наличие множества ссылок, не имеющих отношения к работе, или неуместные суждения о ваших собственных достижениях, ссылки на Ваши предыдущие работы.

В разделе Результаты и Обсуждение – приводится анализ и обсуждение полученных вами результатов исследования. Приводятся выводу по полученным в ходе исследования результатам, раскрывается основная суть. И это один из самых важных разделов статьи. В нем необходимо провести анализ результатов своей работы и обсуждение соответствующих результатов в сравнении с предыдущими работами, анализами и выводами.

Заключение, выводы – обобщение и подведение итогов работы на данном этапе; подтверждение истинности выдвигаемого утверждения, высказанного автором, и заключение автора об изменении научного знания с учетом полученных результатов. Выводы не должны быть абстрактными, они должны быть использованы для обобщения результатов исследования в той или иной научной области, с описанием предложений или возможностей дальнейшей работы.

Структура заключения должна содержать следующие вопросы: Каковы цели и методы исследования? Какие результаты получены? Каковы выводы? Каковы перспективы и возможности внедрения, применения разработки?

Список используемой литературы, или Библиографический список состоит из не менее 15 наименований литературы, и из них 50% на английском языке. В случае наличия в списке литературы работ, представленных на кириллице, необходимо представить список литературы в двух вариантах: первый – в оригинале, второй – романизированным алфавитом (транслитерация).

Романизированный список литературы должен выглядеть в следующем виде: автор(-ы) (транслитерация - http://www.translit.ru) → (год в круглых скобках)→название статьи в транслитерированном варианте [перевод названия статьи на английский язык в квадратных скобках], название русскоязычного источника (транслитерация, либо английское название – если есть), выходные данные с обозначениями на английском языке.

Например: Gokhberg L., Kuznetsova T. (2011) Strategiya-2020: novye kontury rossiiskoi innovatsionnoi politiki [Strategy 2020: New Outlines of Innovation Policy]. *Foresight-Russia,* vol. 5, no 4, pp. 8–30. Список литературы представляется в алфавитном порядке, и ТОЛЬКО те работы, которые цитируются в тексте.

Стиль оформления списка литературы на русском и казахском языке согласно ГОСТ 7.1-2003 «Библиографическая запись. Библиографическое описание. Общие требования и правила составления».

Стиль оформления Романизированного списка литературы, а также источников на английском (другом иностранном) языке – Chicago Style (www.chicagomanualofstyle.org).

В данном разделе необходимо учесть:

- Цитируются основные научные публикации, передовые методы исследования, которые применяются в данной области науки и на которых основана работа автора.
- Избегайте чрезмерных самоцитирований.
- Избегайте чрезмерных ссылок на публикации авторов СНГ/СССР, используйте мировой опыт.
- Библиографический список должен содержать фундаментальные и наиболее актуальные труды, опубликованные известными зарубежными авторами и исследователями по теме статьи.
- Ссылки на цитируемые работы в тексте даются в скобках, с указанием первого автора работы, год издания: номер страниц(-ы). Например, (Залесский, 1991: 25). В случае, наличия в списке литературы нескольких работ одного и того же автора, изданных в один год, то дополнительно к году издания добавляется буква «а», «б» и т.д. Например, (Садуова, 2001а: 15), (Садуова, 2001б, 22).

В случае несоответствия статьи требованиям, редколлегия вправе её отклонить.

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Figures, tables, graphs, diagrams, etc. are presented directly in the text, indicating the numbering and title (For example, Fig. 1 - Figure title). The number of figures, tables, graphs, and diagrams should not exceed 20% of the entire article volume (in some cases up to 30%).

The volume of the article (excluding the title, information about the authors, annotations, keywords, bibliographic list) should be at least 3,000 words and not exceed 7,000 words for socio-humanitarian areas, and 1,500-7,000 words for natural science and technical areas.

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The author (s) of the article - indicating the name and surname, academic degree, academic title, a position held, place of work, city, country, contact phone number, email. Authors' information is presented in a regular font in lowercase letters, alignment - in the center.

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The structure of the annotation includes the following mandatory clauses:

- Introductory remarks about the research topic.
- Purpose, main directions, and ideas of scientific research.
- A brief description of the scientific and practical significance of the work.
- Brief description of the research methodology.
- Main results and analysis, conclusions of the research work.
- The value of the research (the contribution of this work to the relevant area of knowledge).
- The practical significance of the results of the work.
- Keywords/phrases - 3-5 in Kazakh, Russian and English languages.

The data at the beginning of the article (title, authors, abstract, keywords) are given in the original language. This is followed by the same information (without IRSTI) in English. Then in Kazakh or Russian (depending on the language of the main article).

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The introduction consists of the following main elements:

Justification for the choice of topic; relevance of the topic or problem. In justifying the choice of the topic based on the description of the experience of predecessors, it is reported that there is a problem situation (the absence of any research, the emergence of a new object, etc.). The relevance of the topic is determined by the general interest in the study of this object, but the lack of comprehensive answers to the existing questions is proved by the theoretical or practical significance of the topic.

Determination of the object, subject, goals, objectives, methods, approaches, hypothesis, and value of your work. The purpose of the research is connected with the proof of the thesis, that is, the presentation of the research subject in the aspect chosen by the author.

Material and Methods - should consist of a description of the materials and work progress, as well as a complete description of the methods used.

The characterization or description of the research material includes its qualitative and quantitative presentation. The characteristic of the material is one of the factors that determines the reliability of the conclusions and research methods.

This section describes how the problem was investigated: details without repeating previously published established procedures; identification of equipment (software) and description of materials are used, with the obligatory introduction of novelty when using materials and methods.

The scientific methodology should include:

- research question (s);
- put forward hypothesis (thesis);
- research stages;

- research methods;
- research results.

• The literature review section should cover fundamental and new works on the research topics of foreign authors in English (at least 15 works), analysis of these works in terms of their scientific contribution, as well as research gaps that you supplement in your article.

Impossible the presence of many references that are not related to the work, or inappropriate judgments about your own achievements, references to your previous work.

• The Results and Discussion section provides an analysis and discussion of your research results. The conclusion on the results obtained in the course of the study is given, the main essence is revealed. And this is one of the most important sections of the article. It needs to analyze the results of their work and discuss the relevant results in comparison with previous work, analyzes, and conclusions.

• Conclusion, conclusions - generalization and summing up the results of the work at this stage; confirmation of the truth of the statement put forward by the author, and the author's conclusion about the change in scientific knowledge, taking into account the results obtained. Conclusions should not be abstract, they should be used to summarize research results in a particular scientific field, with a description of proposals or opportunities for further work.

The structure of the report should contain the following questions: What are the objectives and methods of research? What are the results? What are the conclusions? What are the prospects and opportunities for implementation, application of development?

○ **Bibliography** or the Bibliographic list consists of at least 30 titles of literature, and 50% of them are in English. If the list of references contains works presented in Cyrillic, it is necessary to submit the list of references in two versions: the first - in the original, the second - in the romanized alphabet (transliteration).

A romanized bibliography should look as follows: author (s) (transliteration - http://www.translit.ru) → (year in parentheses) → article title in transliterated version [translation of the article title into English in square brackets], name of a Russian-language source (transliteration, or English title - if any), printed output in English.

For example: Gokhberg L., Kuznetsova T. (2011) Strategiya-2020: novye kontury rossiiskoi innovatsionnoi politiki [Strategy 2020: New Outlines of Innovation Policy]. Foresight-Russia, vol. 5, no.4, pp. 8-30. The list of references is presented in alphabetical order and ONLY those works that are cited in the text.

Style of the bibliography in Russian and Kazakh languages according to GOST 7.1-2003 "Bibliographic record. Bibliographic description. General requirements and compilation rules "(the requirement for publications included in the Committee for Control in the Sphere of Education and Science list).

The style of the Romanized bibliography, as well as sources in English (another foreign) language for socio-humanitarian areas - American Psychological Association (http://www.apastyle.org/), for natural sciences and engineering - Chicago Style (www.chicagomanualofstyle.org).

For example:

Book

0. Zadie Smith, Swing Time (New York: Penguin Press, 2016), 315-16.

1. Brian Grazer and Charles Fishman, A Curious Mind: The Secret to a Bigger Life (New York: Simon & Schuster, 2015), 12.

Journal article

0. Susan Satterfield, "Livy and the Pax Deum," Classical Philology 111, no. 2 (April 2016): 170.

1. Shao-Hsun Keng, Chun-Hung Lin, and Peter F. Orazem, "Expanding College Access in Taiwan, 1978–2014: Effects on Graduate Quality and Income Inequality," Journal of Human Capital 11, no. 1 (Spring 2017): 9-10, https://doi.org/10.1086/690235.

2. Peter LaSalle, "Conundrum: A Story about Reading," New England Review38, no. 1 (2017): 95, Project MUSE.

Website content

0. "Privacy Policy," Privacy & Terms, Google, last modified April 17, 2017, https://www.google.com/policies/privacy/...

1. "About Yale: Yale Facts," Yale University, accessed May 1, 2017, https://www.yale.edu/about-yale/yale-facts...

2. Katie Bouman, "How to Take a Picture of a Black Hole," filmed November 2016 at TEDxBeaconStreet, Brookline, MA, video, 12:51, https://www.ted.com/talks/katie_bouman_what_does_a_black_hole_look_like...

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• The main scientific publications, advanced research methods that are used in this field of science, and on which the author's work is based are cited.

• Avoid over-quoting.

• Avoid excessive references to publications by authors of the CIS / USSR, use world experience.

• The bibliographic list should contain fundamental and most relevant works published by well-known foreign authors and researchers on the topic of the article.

• References to cited works in the text are given in brackets, indicating the first author of the work, year of publication: number of pages (s). For example, (Zalessky, 1991: 25). If there are several works of the same author published in the same year in the bibliography, the letter "a", "b", etc. is added to the year of publication. For example, (Saduova, 2001a: 15), (Saduova, 2001b, 22).

МАЗМҰНЫ – CONTENTS – СОДЕРЖАНИЕ