ISNN:2181-1296

SHAROF RASHIDOV NOMIDAGI
SAMARQAND DAVLAT UNIVERSITETI

САМАРКАНДСКИЙ ГОСУДАРСТВЕННЫЙ
УНИВЕРСИТЕТ ИМЕНИ ШАРОФА РАШИДОВА

SAMARKAND STATE UNIVERSITY NAMED
AFTER SHAROF RASHIDOV

ILMIY AXBOROTNOMA

НАУЧНЫЙ ВЕСТНИК
SCIENTIFIC JOURNAL

ANIQ VA TABIIY FANLAR SERIYASI

Matematika, Mexanika, Informatika
Fizika, Kimyo, Biologiya, Geografiya

№ 1/2 (155)
2026

ISSN 2181-1296

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Samarqand viloyat matbuot boshqarmasida ro‘yxatdan o‘tish tartibi 09-25.
Jurnal 1999-yildan chop qilina boshlagan va OAK ro‘yxatiga kiritilgan.

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Obuna indeksi – yakka tartibdagi obunachilar uchun **- 5583,**
tashkilot, korxonalar uchun **- 5584**

M U N D A R I J A
C O N T E N T S

№	Maqola nomi	Article title	Bet/ page
1.	Yuqori chastotali II-turdagi radio portlash spektral kuzatuvlaridan foydalanib magnit maydon kuchini baholash **Pulatov D., Mirtoshev Z.**	Estimation Of The Coronal Magnetic Field Strength Using High-Frequency Type Ii Radio Burst Observations **Pulatov D., Mirtoshev Z.**	**5-11**
2.	Rayxon (OCIMUM) o‘simligi efir moyi kimyoviy tarkibiga iqlim omillarining ta’sirini GX–MS usulida tadqiq etish **Siddikova Y., Saifullaeva Sh., Mukhamadiyev A., N.Fazlieva, Nayimova B., Muhamadiyev N.**	Study of the influence of climate factors on the chemical composition of basil (ocimum) essential oil using the GH–MS method **Siddikova Y., Saifullaeva Sh., Mukhamadiev A., N.Fazlieva, Nayimova B., Muhamadiev N.**	**12-20**
3.	Bentonitni montmorillonit bilan boyitishning samarali usullari va termal ishlov berishning kation almashinuvi quvvatiga ta'siri **Mamadoliev I., Abdikamalova A., Ruzieva S.**	Effective methods for bentonite enrichment with montmorillonite and the impact of thermal treatment on cation exchange capacity **Mamadoliev I., Abdikamalova A., Ruzieva S.**	**21-28**
4.	$KPbBr_3$ asosidagi peroled tuzilmalarida zaryad tashish mexanizmlari va energetik sathlarning moslashuvi **Rahmonova M., Muxamadiyev N.**	Charge transport mechanisms and energy level alignment in $KPbBr_3$ -based peroled structures **Rahmonova M., Mukhamadiev N.**	**29-36**
5.	*N*-(4-(((7-Nitroxinazolin-4-il) amino) metil)fenil) siklogeksankarboksamid sintezi **Gaybullaev Sh., Takhirov Y., Chao Niu, Bozorov Kh.**	Synthesis of N-(4-(((7-nitroquinazolin-4-YL) amino) methyl) phenyl) cyclohexanecarboxamide **Gaybullaev Sh., Takhirov Y., Chao Niu, Bozorov Kh.**	**37-41**
6.	3-brom-pirido[2,3-*d*]pirimidinonlarning sintezi **Khushnazarov Z., Turgunov D., Bozorov Kh.**	synthesis of 3-bromo-pyrido[2,3-d]pyrimidinones **Khushnazarov Z., Turgunov D., Bozorov Kh.**	**42-46**
7.	Zarrachalar tezlatkichlarida materiallarning aktivatsiyasi va radiatsion xavflar **Temirov J., Khasanov Sh., Safarov A., Karimberganova Q.**	Material activation and radiological hazards in particle accelerators **Temirov J., Khasanov Sh., Safarov A., Karimberganova Q.**	**47-57**
8.	Geoinformatsion dasturlar yordamida demografik atlaslar yaratishning afzalliklariga nazar **Tukhtamishev Sh., Khudoyarova Sh., Shirinboyev D.**	Advantages of creating demographic atlases using geoinformation software **Tukhtamishev Sh., Khudoyarova Sh., Shirinboev D.**	**58-62**
9.	Siklopropilatsetilen asosida atsetilen spirtlari sintezi, ularning nazariy energetik xarakteristikalari va nadfoksidaza oqsili (7U8G) bilan molekulyar birikish tahlili **Ziyadullaev M.E., Nurmanov S.E., Buriev F.Kh., Abdukhalikov F.J.**	Synthesis of acetylenic alcohols based on cyclopropylacetylene, their theoretical energetic characterization, and molecular docking analysis with nadph oxidase (7U8G) protein **Ziyadullaev M.E., Nurmanov S.E., Buriev F.Kh., Abdukhalikov F.J.**	**63-71**
10.	Tetratsiklik tieno[3,2-*d*]pirimidinonlarning siklooksigenaza-2 ingibitorlari sifatida *in silico* tadqiqi **Nasrullaev A., Buronov A., Gaybullaev Sh., Bozorov Kh.**	In silico evaluation of tetracyclic thieno[3,2-d]pyrimidinones as potential cyclooxygenase-2 inhibitors **Nasrullaev A., Buronov A., Gaybullaev Sh., Bozorov Kh.**	**72-76**
11.	H3PO4, KOH va ZnCl2 yordamida olingan faollashtirilgan ko‘mirning morfologik va strukturaviy xususiyatlarining qiyosiy tahlili **Ergasheva D., Mukhamadiyev A., Mukhamadiyev N., Uzokov J.**	Comparative analysis of the morphological and structural properties of activated carbon prepared using H_3PO_4, KOH, and $ZnCl_2$ **Ergasheva D., Mukhamadiev A., Mukhamadiev N., Uzokov J.**	**77-81**
12.	CO_2 NI quyosh nuri ta’sirida samarali konversiyalashni ta’minlovchi g-C_3N_4/$CoNi_2S_4$ geterotuzilmali nanomateriallar sintezi va fizik-kimyoviy xossalari **Samiev A., Nizamov U.N., Mirzaev Sh., Ruzimuradov O., Nasimov A.**	Synthesis and physicochemical properties of γ-C3N4/CoNi2S4 heterostructured anomaterials providing efficient conversion of CO2 under the influence of sunlight **Samiev A., Nizamov U.N., Mirzaev Sh., Ruzimuradov O., Nasimov A.**	**82-87**

№	Maqola nomi	Article title	Bet/ page
13.	Atrof muhitdagi ammiak mikrokensentratsiyasini monigitori uchun gibrid perovskit $MA_xFA_{1-x}PbI_3$ fluoressent sensori tayyorlash **Eshmuradova G.B., Tashpulatov Kh.Sh., Khursandov J.M., Normuradov O.U., Norboyev Q.M., Toshpulatov D.T.**	Preparation of hybride perovskite $MA_xFA_{1-x}PbI_3$-fluorescent sensor for the monitoring of ammonia microconcentration in environment **Eshmuradova G.B., Tashpulatov Kh.Sh., Khursandov J.M., Normuradov O.U., Norboev Q.M., Toshpulatov D.T.**	**88-92**
14.	Al^{3+} bilan modifikatsiyalangan shpinel tuzilishga ega $Li_{1.33}Al_XMn_{1.67-X}O_4$ ($0 \leq x < 0.7$) tarkibli adsorbentlarning zol-gel sintezi va fizik-kimyoviy xossalari **Begimkulova Sh.A., Nematova Sh.Sh., Baxriev I.S., Mirzaev Sh.E., Ruzimuradov O.N., Nasimov A.M.**	Sol-gel synthesis and physicochemical properties of adsorbents consisting of Al^{3+} modified spinel structure $LI_{1.33}Al_XMn_{1.67-X}O_4$ ($0 \leq X < 0.7$) **Begimkulova Sh.A., Nematova Sh.Sh., Baxriev I.S., Mirzaev Sh.E., Ruzimuradov O.N., Nasimov A.M.**	**93-99**
15.	CdCr2Se4 va CuCr4Se4 magnitli yarimo‘tkazgichda magnit-optik effektlar **Dosmurodov G.**, **Kurbaniyazov A.**, **Boboqambarova G.**	Magneto-optical effects in the magnetic semiconductor CdCr2Se4 AND CuCr4Se4 **Dosmurodov G.**, **Kurbaniyazov A.**, **Bobokambarova G.**	**100-104**
16.	Sophora lehmanni va Cicer mogoltavikum o‘simliklari yer ustki qismilarining flavonoidlari **Gafurov A.Zh, Botirov E. Kh.**	Flavonoids of aerial parts of sophora lehmannii and cicer mogoltavicum **Gafurov A.Zh, Botirov E. Kh.**	**105-109**
17.	Buxoro viloyatining balneologik resurslari va ularning aholi salomatligini yaxshilashdagi ahamiyati **Zaynutdinova D.K., Nematova Kh. Kh.**	Balneological resources of the bukhara region and their significance in improving public health **Zaynutdinova D.K., Nematova Kh. Kh.**	**110-116**
18.	Tabiiy cho‘kuvchan gruntlarni polimer-kompozitsion eritmalar bilan inyeksion mustahkamlash texnologiyasini matematik rejalashtirish **Bakhriyev N.F., Kholiqulov O.O., Nurmatova R.K.**	Mathematical planning of injection strengthening technology of natural collapsible soils using polymer-composite solutions **Bakhriyev N.F., Kholikulov O.O., Nurmatova R.K.**	**117-125**
19.	Adgezion kontaktlarda ishqalanish koeffitsiyentiga geometrik parametrlar hamda tashqi yuk ta’sirining tahlili **Bekmamatova G., Xoliqulov O., Tojinorov M.**	Analysis of geometric parameters and external load on the friction coefficient in adhesive contacts **Bekmamatova G., Xolikulov O., Tojinorov M.**	**126-131**
20.	Markaziy Osiyo iqlim sharoitida sorbsion sovutgichlardan biogaz komplekslari bilan simbiozda foydalanish istiqbollari **Abdusamiyev F., Bahriev S., Sattarov S.**	Prospects for using sorption refrigerators in symbiosis with biogas complexes in the climatic conditions of Central Asia **Abdusamiev F., Bahriev S., Sattarov S.**	**132-136**
21.	Maple tizimida algebraik ko’pxilliklarni ratsional parametrlashining nazariy asoslari va kompyuterda amalga oshirilishi **Usmonova N.**	Theoretical foundations and computer implementation of rational parameterization of algebraic manifolds in the maple system **Usmonova N.**	**137-142**
22.	$Fe_5Ga_6Gd_2YZr$ ko‘p komponentli kristallining element tarkibi va tebranish xossalarini rentgen-fluoresans (XRF) va raman spektroskopiyasi yordamida tadqiq etish **Nasirova N., Fayziyev Sh., Saidov Q., Qaxorova Sh., Sharipov M., Djuraev D.**	Investigation of the elemental composition and vibrational properties of the multicomponent crystal Fe5Ga6Gd2YZr using X-RAY fluorescence (XRF) and raman spectroscopy **Nasirova N., Fayziyev Sh., Saidov Q., Qaxorova Sh., Sharipov M., Djuraev D.**	**143-152**
23.	Xofp tipidagi tenglamalar sistemasi uchun Koshi masalasi **Erkinova D. A.**, **Imomnazarov Kh. Kh.**	Cauchy problem for a Hopf-type system **Erkinova D. A.**, **Imomnazarov Kh. Kh.**	**153-157**
24.	Ar va HCl izotopologlari o‘rtasida hosil bo‘lgan komplekslarning kvant-kimyoviy tahlili: AIM, RDG va NCI usullari yordamida solvatatsiya effektlarini o‘rganish **Khujamov U.**	Quantum-chemical analysis of complexes formed between Ar and HCL isotopologues: studying solvation effects using AIM, RDG, and NCI methods **Khujamov U.**	**158-167**

UDC: 911.3 https://doi.org/10.59251/2181-3973.2025.v1.138.1.3830

BALNEOLOGICAL RESOURCES OF THE BUKHARA REGION AND THEIR SIGNIFICANCE IN IMPROVING PUBLIC HEALTH

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Received: 19.01.2026
Revised: 30.01.2026
Accepted: 18.02.2026
Published: 30.03.2026

Publisher: Samarkand State University named after Sharof Rashidov.

Abstract. The article examines the balneological resources of the Bukhara region as an important component of its regional medical-geographical potential. The natural therapeutic factors of the territory, including mineral waters, therapeutic muds, and climatic conditions, as well as their influence on disease prevention and health rehabilitation of the population, are analyzed. Particular attention is paid to the spatial distribution of balneological facilities and their role in the formation of the region's sanatorium and resort infrastructure. The objects of the study are the Alat Salt Therapy Center, the "Issyk-Suv" Sanatorium, and the "Sitorai Mohi Khosa" Sanatorium, which reflect the main directions of the use of balneological resources in the Bukhara region. Based on the analysis of natural-geographical and socio-ecological factors, the importance of rational use of balneological resources for reducing morbidity and improving the quality of life of the population is substantiated.

Keywords: balneological resources, mineral waters, therapeutic muds, public health, sanatorium-resort treatment, disease prevention, health-improving tourism.

Buxoro viloyatining balneologik resurslari va ularning aholi salomatligini yaxshilashdagi ahamiyati

Annotatsiya. Maqolada Buxoro viloyatining balneologik resurslari uning hududiy tibbiy-geografik salohiyatining muhim tarkibiy qismi sifatida o'rganilgan. Hududning tabiiy davolovchi omillari, jumladan mineral suvlar, shifobaxsh loylar hamda iqlimiy sharoitlar, shuningdek, ularning aholi o'rtasida kasalliklarning oldini olish va sog'liqni tiklash jarayoniga ta'siri tahlil qilingan. Balneologik obyektlarning hududiy joylashuvi va ularning viloyat sanatoriy-kurort infratuzilmasini shakllantirishdagi o'rniga alohida e'tibor qaratilgan. Tadqiqot obyektlari sifatida Buxoro viloyatida balneologik resurslardan foydalanishning asosiy yo'nalishlarini aks ettiruvchi Olot tuz bilan davolash markazi, "Issiq-Suv" sanatoriysi hamda "Sitorai Mohi Xosa" sanatoriysi tanlab olingan. Tabiiy-geografik va ijtimoiy-ekologik omillarni tahlil qilish asosida balneologik resurslardan oqilona foydalanish aholining kasallanish darajasini kamaytirish va hayot sifatini yaxshilashda muhim ahamiyatga ega ekanligi asoslab berilgan.

Kalit so'zlar: balneologik resurslar, mineral suvlar, davolovchi loylar, aholining salomatligi, sanatoriy-kurort davolash, kasalliklarni profilaktika qilish, davolash-sog'lomlashtirish turizmi.

Бальнеологические ресурсы Бухарской области и их значение в улучшении здоровья населения

Аннотация. В данной статье рассматриваются

бальнеологические ресурсы Бухарской области как важный компонент регионального медико-географического потенциала. Проанализированы природные лечебные факторы территории, включая минеральные воды, лечебные грязи и климатические условия, а также их влияние на профилактику и восстановление здоровья населения. Особое внимание уделено пространственным особенностям размещения бальнеологических объектов и их роли в формировании санаторно-курортной инфраструктуры региона. В качестве объектов исследования выбраны Алатский центр солетерапии, санатории «Иссык сув» и «Ситораи Мохи Хоса», которые отражают основные направления использования бальнеологических ресурсов Бухарской области. На основе анализа физико-географических и социально-экологических факторов обоснована значимость рационального использования бальнеологических ресурсов для снижения уровня заболеваемости и повышения качества жизни населения.

Ключевые слова: бальнеологические ресурсы, минеральные воды, лечебные грязи, здоровье населения, санаторно-курортное лечение, профилактика заболеваний, лечебно-оздоровительный туризм.

Introduction. In the modern context of increasing anthropogenic impact and changes in climatic factors, the study of natural therapeutic resources as a basis for preserving and strengthening public health is becoming particularly relevant. Within the system of medical-geographical research, balneological resources occupy an important place, including mineral waters, therapeutic muds, and favorable climatic conditions that possess significant preventive and rehabilitative potential. In the United Nations Agenda for Sustainable Development until 2030, Goal 3 - “Ensure healthy lives and promote well-being for all at all ages” - is aimed at addressing issues related to the protection of public health [8]. Achieving this goal requires an analysis of territorial characteristics and differences in the health status and morbidity levels of regional populations, as well as consideration of the influence of environmental and socio-economic factors. This, in turn, implies a targeted and scientifically grounded approach to identifying existing problems and developing effective measures to address them.

The Bukhara region is characterized by an arid climate, a shortage of water resources, and specific geoecological conditions, which create prerequisites for the development of sanatorium-resort and health-improvement activities. At the same time, existing data on the region’s balneological facilities remain insufficiently systematized; their impact on public health requires more in-depth scientific analysis, while territorial differentiation and socio-economic factors remain poorly studied. The research problem lies in the need for a scientifically substantiated approach to the assessment, protection, and rational use of the balneological resources of the Bukhara region as an important element of the region’s medical-geographical potential. The lack of comprehensive data limits the possibilities for applying natural therapeutic factors for disease prevention, reducing morbidity, and improving the quality of life of the population.

Literature Review. The study of recreation within the system of geographical sciences developed in different countries during various historical periods. In foreign geographical science, particularly in the USA and the UK, research on recreation and tourism began to develop actively in the 1930s–1940s. Initially, these studies were considered mainly within the framework of economic geography and were focused on analyzing the impact of recreational activities on the development of specific regions, especially resort and coastal areas [12–13]. In the countries of the former Soviet Union, recreation geography emerged as an independent scientific field in the 1960s under the name “recreational geography”. A significant contribution to the formation of this field was made by the works of Y.A.Vedenin, I.V.Zorin, L.I.Mukhina, L.S.Filippovich, and other researchers working under the guidance of V.S.Preobrazhensky [15–16]. The publication of the fundamental monograph *Theoretical Foundations of Recreational Geography* in 1975 became an important milestone in the development of scientific understanding of the spatial organization of recreational activities [9]. In

Uzbekistan, the development of recreation and tourism geography is closely linked to the formation of the sanatorium-resort sector in the 1970s, which created objective prerequisites for the intensification of scientific research in this field. In subsequent decades, recreational and tourism issues became one of the priority research areas of geographical science in the republic, within which major research schools were formed and a number of dissertations were defended [5; 10]. The scientific foundations of recreational geography in the republic were developed in the works of Z.Makhamatillaev (1972) [6], A.Yusupov (1995) [11], M.Usmonov (2024) [10], A.Mavlonov (2026) [5], and other scholars. These studies are of significant methodological importance, as they addressed issues of the spatial organization of recreational activities, assessment of the recreational potential of natural resources, and socio-economic conditions for tourism development. Overall, the geography of recreation develops in close interrelation with medical geography, tourism geography, and resort management, allowing for a comprehensive consideration of issues related to public health improvement, rational use of natural resources, and sustainable development of recreational territories [1–2;7;14]. At the same time, an analysis of scientific sources shows that the balneological resources of the Bukhara region remain insufficiently studied from a comprehensive medical-geographical perspective. This highlights the relevance of the present study and the need for further scientific justification of their role in enhancing public health and developing the regional recreational system.

Aim of the Study. In the context of the arid climate of the Bukhara region and increasing anthropogenic impacts on the natural environment, issues of public health protection assume particular significance. The deterioration of the ecological situation-associated with industrial load, soil degradation, water scarcity, and rising levels of environmental pollution-negatively affects population health and increases the need for effective preventive and restorative measures. In this context, natural healing factors and the region's balneological resources play a special role as components of its medical-geographical potential. The aim of the present study is a comprehensive medical-geographical assessment of the balneological resources of the Bukhara region under deteriorating ecological conditions, and a substantiation of their significance for disease prevention, health restoration, and the development of therapeutic and recreational tourism.To achieve this aim, the study addresses the following objectives:

1. To analyze the physical-geographical and ecological conditions of the Bukhara region, including anthropogenic impacts on the environment.
2. To identify the main types of balneological resources in the region (mineral waters, therapeutic muds, and climatic factors) and determine their formation characteristics.
3. To provide a medical-geographical characterization of the functioning of the Alat Salt Therapy Center and the "Issiq-Suv" and "Sitorai Moxi Xosa" sanatoriums as key facilities utilizing natural healing resources.
4. To assess the significance of balneological resources in reducing disease incidence and improving the population's quality of life under conditions of ecological stress.

Research Methods and Study Objects. The methodological basis of the study comprised systemic, comparative-analytical, and medical-geographical approaches, which allowed balneological resources to be considered as an interconnected component of the natural-geographical environment, ecological conditions, and public health. Within the framework of the systemic approach, balneological resources were analyzed together with the physical-climatic, ecological, and socio-economic characteristics of the territory. The comparative-analytical approach was used to examine the spatial distribution and degree of utilization of natural healing factors across different districts of the Bukhara region [18–19]. The medical-geographical approach enabled the evaluation of the impact of balneological resources and ecological factors on population health, as well as their role in disease prevention and morbidity reduction. A thorough analysis of scientific publications and theoretical sources on balneotherapy and recreational geography was conducted. Observational data collected by the authors during the study of the functioning of balneological facilities and the organization of therapeutic-recreational activities in the region were also incorporated.

Results and Discussion. The Bukhara region is characterized by a sharply continental climate: summers are hot and dry, while winters are cold. Average annual precipitation ranges from 90 to 150 mm, and the growing season lasts approximately 220 days. The climate corresponds to that of southern (subtropical) deserts and is highly continental. Diurnal temperature fluctuations reach 15–20 °C. During winter and spring, winds are frequent, often accompanied by dust and sand storms. The main sources of water are the Zarafshan River and the Amu-Bukhara and Amu-Karakul canals, which

play a key role in the regional irrigation system [4]. These physico-climatic and hydrological characteristics provide favorable conditions for the development of the region's balneological resources. The arid climate, intense solar radiation, large daily temperature fluctuations, and the presence of mineral waters create optimal conditions for the application of physical factors for therapeutic and health-promoting purposes [3].

Alat Salt Therapy Center. The therapeutic salt lake, located in Alat district of the Bukhara region near the state border with Turkmenistan, is a relict natural formation. It originated from the degradation of an ancient water body under arid climatic conditions. The lake is highly mineralized, forming a unique natural complex used for therapeutic and health-promoting purposes. Based on this natural object, a therapeutic-recreational zone operates as the Sand-Salt Therapy Center, located approximately 24 km from the district administrative center. The site is situated within a desert landscape, between the salt lake and sand dunes, which defines its specific physico-climatic conditions [21]. The balneological and climatotherapeutic significance of the complex arises from the combination of highly mineralized salt deposits, heated sands, and intense solar radiation, all of which exert a favorable physiological effect on the human body. During the summer period, particularly at the peak of thermal load (from late June to early August), the facility is primarily used for therapeutic purposes. Patients visit the center from various regions of Uzbekistan and neighboring countries. Under high insolation, the sand surface heats up to 70–80 °C, while climatic conditions are characterized by low humidity and frequent dry hot winds (locally known as garmsel), enhancing the thermotherapeutic effect. Therapeutic procedures are based on psammotherapy and salt therapy methods, including short-term (10–15 min) exposure of the body to heated sand, followed by the application of phytotherapeutic remedies. The average duration of a treatment course is 3–5 days (Figure 1).



Figure 1. Psammotherapy and salt therapy facility in Alat district (Bukhara region).

According to long-term observations and the generalization of traditional medicine practices, these methods have demonstrated positive effects in the treatment of musculoskeletal disorders, including pain syndromes in the lower back and lower extremities, as well as disorders of salt metabolism and osteochondrosis (Table 1).

To ensure the effective operation of the therapeutic-recreational zone, a basic infrastructure has been established, including more than 30 temporary residential structures (yurt-type), dining, recreational, and sanitary facilities. This infrastructure enhances the accessibility and effectiveness of therapeutic procedures and contributes to the development of a local center for therapeutic and recreational tourism.

Main balneological sanatoriums of the Bukhara region and their therapeutic resources

Table 1

Name of Sanatorium	Geographical location and natural conditions	Main therapeutic factor	Treatment indications
Alat salt therapy center	Bukhara region, Alat district, around a salt lake, desert landscape. Dry continental climate, high summer temperatures and	Salt procedures (halotherapy), sand baths (psammotherapy), aerotherapy.	Respiratory system: chronic bronchitis, mild bronchial asthma, allergic rhinitis. Musculoskeletal system: rheumatism, arthritis, lower back pain. Nervous system: chronic

	low humidity. Natural salt deposits are present.		fatigue, neurosis. Skin diseases: eczema, allergic dermatitis. General rehabilitation: strengthening immunity and hardening of the body.
"Sitorai Moxi Xosa" sanatorium	Eastern part of the city Bukhara, in the Zarafshan river valley, in a dry subtropical climate zone. Elevation 220–250 m above sea level. Continental climate with a high number of sunny days.	Climatotherapy (aerotherapy), balneotherapy, health-improving procedures.	Urinary system: chronic pyelonephritis (remission), cystitis, urolithiasis. Digestive system: chronic gastritis, colitis, post-hepatitis recovery. Nervous system: neurosis, vegetative-vascular dystonia, stress syndrome. Musculoskeletal system: arthritis, arthrosis, osteochondrosis, radiculitis.
"Issiq suv" sanatorium	Bukhara district, approximately 8 km from Bukhara city. Intersection of desert and river landscapes. Underground thermal waters rise from a depth of 1200 m.	Mineral thermal water 50–52°C (hydrocarbonate-chloride-sodium composition), hydrotherapy.	Cardiovascular system: stage I–II hypertension, mild ischemic heart disease. Endocrine system: type 2 diabetes mellitus (compensated stage). Musculoskeletal system: osteochondrosis, arthritis, polyarthritis, myositis. Nervous system: neuralgia, peripheral neuritis. Gynecological diseases.

Table compiled by the authors during the study

The sanatorium "Sitorai Moxi Xosa" is a climatic and balneological therapeutic-recreational institution located in the Zarafshan river valley, at an altitude of approximately 500 m above sea level, on the northern outskirts of Bukhara city. The geographical location of the sanatorium within the river valley provides a relatively favorable microclimate, characterized by reduced air dustiness, enhanced aeration, and moderation of extreme temperature conditions typical for the arid territories of the region. The climatic conditions of the sanatorium's location are distinguished by high solar radiation, low air humidity, and a prolonged warm period, which creates favorable prerequisites for climatotherapy and restorative procedures [20]. Combined with the use of local balneological factors, these conditions contribute to the activation of metabolic processes, normalization of nervous system functions, and enhancement of the body's adaptive capabilities (Figure 2).The therapeutic profile of the sanatorium is focused on rehabilitation and prevention of a range of chronic diseases. In particular, the treatment of urinary system disorders is based on the use of mineral waters with diuretic and anti-inflammatory properties, as well as climatotherapeutic procedures that omote improved renal hemodynamics and water-salt balance.



Figure 2. Sanatorium "Sitorai Moxi Xosa" (Bukhara region).

Restoration of nervous system functions is carried out using gentle climatic factors, physiotherapeutic methods, and balneological procedures aimed at reducing psycho-emotional stress

and normalizing autonomic regulation [17]. Special attention at the sanatorium is given to the treatment of digestive system disorders, which involves the use of drinking mineral waters, diet therapy, and physiotherapeutic methods that contribute to the improvement of secretory and motor functions of the gastrointestinal tract.

Rehabilitation of patients with musculoskeletal disorders includes a set of balneological procedures, therapeutic physical exercises, and climatotherapy aimed at reducing pain, improving joint mobility, and restoring muscle tone.

The sanatorium "Issiq suv" was established in August 1980 and is located 8 km from Bukhara city, within the territory of Bukhara district, in an area removed from dust and noise. The sanatorium covers an area of 4 ha, consisting of a dense green zone with trees emitting phytoncides (pines, junipers, fruit trees), as well as ornamental roses. From a depth of 1200 meters, mineral water emerges on the anatorium's territory with a temperature of 52 °C,considered the "pearl" and hallmark of the institution (Figure 3).



Figure 3. Sanatorium "Issiq suv" (Bukhara region).

According to hydrogeologists, the mineral water was formed as a result of millennia-long effects of gravitational, physicochemical, and microbiological processes. Its composition includes bicarbonates, carbonates, and sulfates of sodium (Na), potassium (K), calcium (Ca), magnesium (Mg), iron (Fe), as well as silicic acid, radon, and other trace elements and gases, which play an important role in patient health improvement [22]. Under these conditions, diseases of the cardiovascular system (hypertension, cardioneuroses), central and peripheral nervous system (neuritis, radiculitis, post-stroke consequences), digestive tract, musculoskeletal system, endocrine and gynecological disorders, as well as pediatric neurological conditions, are effectively treated.

Conclusions. The analysis of balneological resources in Bukhara region demonstrates the high therapeutic significance of climatic, hydrothermal, and salt factors. The "Sitorai Moxi Xosa" sanatorium primarily uses climatotherapy and balneotherapy for the treatment of genitourinary, digestive, and nervous systems, as well as the musculoskeletal system. Sanatorium "Issiq suv " facility is focused on hydrotherapy using thermal mineral waters, which is effective for cardiovascular, endocrine, and musculoskeletal pathologies, as well as dermatological and urological diseases. The salt complex in Olot district specializes in halotherapy and sand baths, contributing to the restoration of the respiratory system, strengthening immunity, and improving the condition of the nervous system and skin.

Thus, regional natural therapeutic resources provide comprehensive health improvement for the population, confirming the importance of their systematic study and use in medical practice. This highlights the potential of Bukhara region as a significant center for climatic and balneological treatment.

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ISSN 2181-1296