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Territorial Assessment of the East Kazakhstan Geo/Ecotourism: Sustainable Travel Prospects in the Southern Altai Area

Jiri Chlachula ^{1,2,*}, Nazgul Zh. Zhensikbayeva ^{3,*}, Anna V. Yegorina ³, Nazym K. Kabdrakhmanova ⁴, Jolanta Czerniawska ⁵ and Sanat Kumarbekuly ³ 

¹ Institute of Geocology and Geoinformation, Department of Geomorphology, Adam Mickiewicz University, B. Krygowskiego 10, 61-680 Poznań, Poland; paleo@amu.edu.pl

² Environmental Research Centre, Nerudova 2181, 686 03 Stare Mesto, Czech Republic

³ Department of Ecology and Geography, Sarsen Amanzholov East Kazakhstan State University, 34 Gvardeiskoy Divizii, 070000 Ust'-Kamenogorsk, Kazakhstan; av_egorina@mail.ru (A.V.Y.); sanat_kv@mail.ru (S.K.)

⁴ Department of Physical and Economy Geography, L.N. Gumilyev Eurasian National University, 2 Satpaeva, 010008 Nur-Sultan, Kazakhstan; knazym90@mail.ru

⁵ Institute of Geocology and Geoinformation, Anthropocene Research Unit, Adam Mickiewicz University, B. Krygowskiego 10, 61-680 Poznań, Poland; jolczer@amu.edu.pl

* Correspondence: naz_zanybek@mail.ru (N.Z.Z.); Altay@seznam.cz (J.C.)



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Abstract: In spite of picturesque landscapes, natural beauties and authentic traditional lifestyles to be seen in East Kazakhstan, tourism is far from being developed. The Kazakh Altai (called the Kazakh Switzerland) is one the most colourful parts of the country and, indeed, all Central Asia. The attractiveness of this geographically isolated region (formerly a part of the Imperial Russia), consisting of rocky semi-deserts, vast parkland-steppes, and rugged mountain terrains, is reflected in its distinctive geological and geomorphological character, its pristine nature, and its extraordinary geodiversity and biodiversity. This study presents a roster of geotourism and ecotourism loci for the broader Altai area within a framework of sustainable development. The modelled assessment of the tourism and recreation potential is based upon multi-proxy analyses of GIS, DEM, and cartographic data. It integrates the most appealing natural (biotic and abiotic) site-specific natural features across all physiographic zones within a broad region. The most significant and representative geosites fall within three geographic sectors suitable for geo- and ecotourism. Prospects for travel to these places are enhanced by the presence of numerous prehistoric archaeological sites and historical monuments, which document the rich, multi-ethnic background of Kazakhstan and the ancient Silk Road that traverses it. These geological, environmental and cultural resources, and the regional geoheritage and environmental conservation concepts have been figured into strategies for economic growth of rural Kazakhstan. Visitors travelling to this most appealing region are constrained by climate of pronounced continentality, seasonality, geographic accessibility, the international border-zone regulations and a lack of services of an international standard.

Keywords: Southern Altai; geosites; geodiversity; ecosystem, recreation; sustainable development

1. Introduction

Kazakhstan, as the largest country of the post-Soviet Central Asia is endowed with immense natural and cultural riches that from far have not been explored and exploited. This fact reflects the minor role of the tourism industry in terms of the national income. Limiting factors such as the cultural and linguistic barriers and a lack of the local stakeholders' and guides' experience restrain the tourism expansion, primarily in the more distant rural regions with poor infrastructure and accommodation facilities. The few places visited on a regular basis are located close to the major cities. The primary role with respect to foreign tourism as well as domestic recreation plays the former capital city, Almaty (Alma-Ata),

situated on the western foothills of the Tian-Shan Mountains (5000–6000 m asl.) with numerous year-round resorts offering a wide range of activities in addition to World nature heritage sites [1–3]. Although there are other, most attractive locations in the Kazakh (Southern) Altai [4,5], the Tarbagatai and the Alatau Mountains, these still remain close to unknown and “tourism-virgin” contrary to the neighbouring montane areas of Xinjiang, western China [6–9] or the Russian Altai [10–12] (Figure 1).

The broader Altai region, encompassing the Gorno Altai, the Mongolian and Chinese Altai and the Southern Altai of East Kazakhstan (Figure 1) is re-known for its supreme natural beauty, mosaic geodiversity and unique cultural heritage. The territory of the Southern Altai has been occupied since the earliest stages of the prehistory [13,14] with the world-famous archaeological sites of the early Iron-Age Scythian civilization [15–18]. The region is eminent for the large variety of flora and fauna species hosted by the relief-specific biotopes found across all the geographic and topographic zones from the arid grasslands to the alpine tundra [19]. The broad geomorphic diversity of the East Kazakhstan landscapes [20,21] with deep erosional canyons cutting through the old geological formations, rocky hills structured by the uplifted and weathered granitic bedrock [22,23] as well as cave sites and rock-shelters/abris makes the region most appealing for tourism and recreation.



Figure 1. Geographical location of the investigated area, East Kazakhstan Region, with the main tourism and nature recreation districts: 1-Katon Karagay NP, 2-Lake Markakol, 3-Kurchum.

The Kazakh Altai and the adjoining rural regions have been largely untouched by mass tourism of any form comparing to the Russian Gorno Altai in spite of a geographic unity and proximity of both regions [11,24,25]. About 3000–4000 people only visit the most attractive places of Lake Markakol and the Kaldzhyr River area during the summer season [26]. In the mid-2000s, merely a few dozens of foreign tourists visited the Katon-Karagay National Park, being the major state-protected territory in Kazakhstan [27]. The expansion of the local tourism is bound to the supreme places (geosites) combined with the traditional rural economy highlights and interesting domestic facilities such as red-deer and horse-breeding farms, home spas (*banyas*) and yurts—among others.

The region has experienced a certain opening to visitors in the reaction to the loosening of entry restrictions of the formerly closed Kazakh-Russian/Chinese border-zone. Eastern Kazakhstan and the adjoining trans-border regions of Gorno Altai/Xinjiang, respectively, are becoming increasingly exposed to the pressure of an uncontrolled (wild) and largely domestic tourism, negatively affecting the local countryside communities and their lifestyles [28,29]. Except for the direct environmental threats (such as nature polluting or biodiversity loss) and the potentially harmful social challenges imposed on the local pastoral people by the visitors' travel and recreation, the opening to these rural and geographical marginal regions of Kazakhstan generates risks to the authentic ethnic milieu in terms of the traditional customs as well as material culture. The latter includes, among other, damage to the unique, freely accessible geosites and the cultural heritage sites (e.g., by construction or graffiti on prehistoric rock art monuments). In spite of this, the East Kazakhstan rural areas have the best predispositions for geo/ecotourism and the local nature-friendly recreation activities (including international).

Geotourism, as the modern branch of tourism of geologically interesting and/or outstanding places (relief features and geological formations) [30,31] may play in the future a major role in the Kazakhstan's tourism development. Presently, the national conceptions of geoheritage aimed at preservation and protection of the country's exclusive landscape forms following the global trends [32,33] is still rather minor and the public awareness of the reliefs' value rather low [21]. Ecotourism aimed at general nature-appreciation and learning along with the visitors' environment-friendly attitudes and behaviour [34], on the contrary, is being firmly implemented in the rural Kazakh tourism activities and programmes. Geotourism is here considered as ecotourism seen from a geological/geomorphic perspective [35]. In the present Altai region study framework, the concept of geo/ecotourism complies with the principal definition criteria of a nature-based activity, environmental education/interpretation and sustainability [36].

This study provides a modelled territorial assessment of travel differentiation and rural recreation sustainability in the Kazakh Altai and the adjoining parts of eastern Kazakhstan foothills from the integrated geo/ecotourism perspective [37]. The tourism research concept combines the most distinctive physio-geographic features along with rich biodiversity and cultural heritage of the area under investigations historically occupied by the traditional pastoral communities. These regional assets offer in a unity the best predispositions for the modern recreation and international tourism development in balance with the traditional social and cultural environment, and nature (including the local Kazakh customs' conservation and the landscape relief protection, respectively).

2. Study Area

The investigated area lies in the foothill and mountain zone of the Southern Altai including the adjoining steppes in the Russian-Kazakh-Chinese border zone of East Kazakhstan [38]. From the east, in the upper reaches of the Bukhtarma River, the study area adjoins the Plateau Ukok/the World (UNESCO) Natural Heritage Site (2200–2600 m asl.) fed by glacial waters of the Tabon Bodgo Ola Range (4356 m) and the Southern Altai Range (3483/3871 m) [39]. In the north, the study area is delimited by the Chokpartas Range (3142 m), the Katun' Range (4506 m) and the Listviyga Range (2578 m) of the Russian Gorno Altai. The Narym (2533 m) and Sarym-Sakty (3373 m) Massifs, lining up the Bukhtarma River valley from the south, represent the western margins of the Central Asian mountain systems [40] (Figure 1).

The formation of the Altai relates to the Caledonian and Hercynian orogenesis [41] followed by the Mesozoic continental planation succeeded by the reactivated late Tertiary/early Quaternary regional neotectonics [42–46] giving rise to numerous metallogenic and gemstone-bearing bodies [47,48]. Structurally, the mountains are formed by the Palaeozoic sedimentary rocks (sandstone, limestones) with intrusions of metamorphic slates, gneiss and granites [22,49]. The present alpine relief was principally shaped by the periodic Quaternary glaciations accompanied by the intensive fluvial erosion and gravity slope

processes active in the main mountain valleys and creating the most spectacular landforms of the Last Glacial Stage (24,000–12,000 years ago). These most dynamic glacigenic actions were triggered by mass-flow cataclysmic drainages of the ice-dammed glacial water during the Late Pleistocene deglaciation stages of the mountain ice cover. The acting geomorphic processes sculpturing the Ice Age relief of the broader Altai are considered as ones of the most catastrophic events in the recent Earth history [50–52]. In the extra-glacial areas, the Quaternary climatic fluctuations contributed to formation of an extensive aeolian (sand and loess) cover mantling the smoothly undulating topographic elevations of the southern Altai foothills [13].

The present warming in the alpine zone shows progressive glacial degradation and the mountain ice retreat in the Kazakh Altai and the adjoining Gorno Altai [53], exposing a fresh glacial topography with prominent ice-erosional and depositional landforms. Light chestnut soils and dark brown chernozems create the pedogenic surface cover in the river and lake basins; brunisolic and regosolic soils characterize the mountain areas [27,54]. Continental climate conditions prevail with marked seasonal weather variations across the country [55]. Mean annual air temperature (MAAT) in the eastern parts of the region is $-4/+1$ °C; average January temperature $-13/-17$ °C and average July temperature $+15/+19$ °C, with absolute temperature minima -50 °C and maxima $+45$ °C. Pronounced differentiation in the precipitation distribution reflects the diverse topography, with the more humid northern (350–700 mm MAP) and NE parts of the territory exposed to the NW atmospheric (Atlantic) air-mass flows, and the (semi-)arid western and especially the southern districts due to the relief precipitation shadow (250–400 mm MAP) [56].

The mosaic regional relief with green riparian valleys contrasting with arid steppes, lush alpine meadows and the high-altitude mountain tundra reflects the great altitudinal landscape gradient and the rather outstanding geodiversity on a relatively small area. Rocky semi-deserts, taiga forests and alpine tundra are the principal biotopes (Figure 2) hosting characteristic flora and fauna with many endemics rare or absent elsewhere in the mid-latitude Eurasia mountains. The preserved prehistoric and early historical sites found across the territory bear witness to the sequenced early human occupation and human adaptation to the mosaic mountain and parkland-steppe ecosystems [14,57,58].

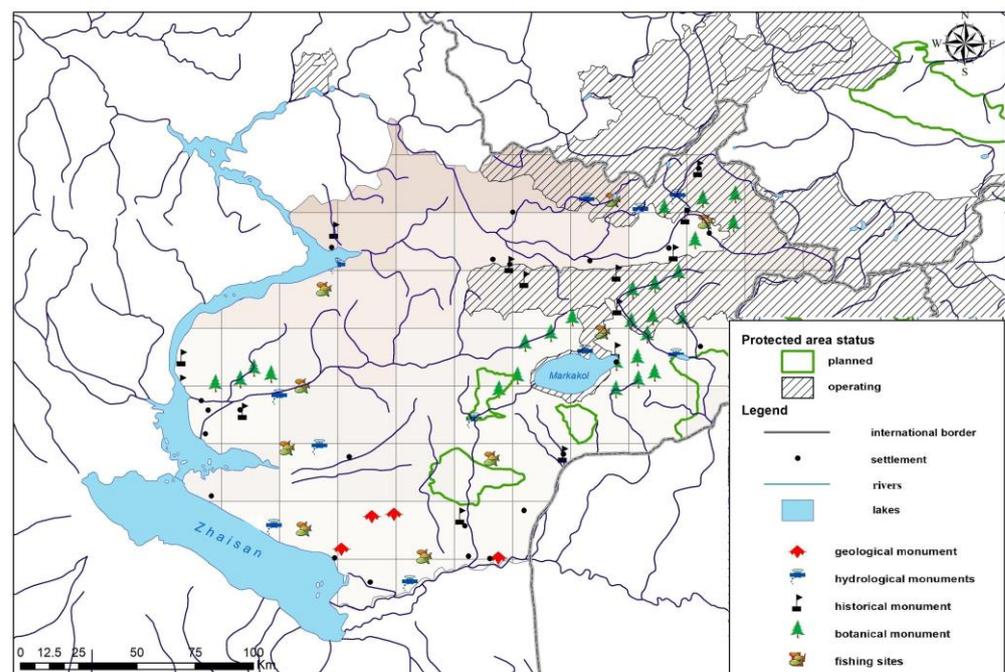


Figure 2. Map of the main natural and cultural sites, and the present recreation places integrated in the geographical OTU system on the territory of eastern Kazakhstan/the Southern Altai area.

3. Research Aims, Methods and Approaches

The present study on the tourism potential and its sustainability in the Southern Altai Mountains and the parkland-steppe foothills included field investigation and GIS- and DEM modelled field data qualitative evaluation. The applied methodology is based on a geographically consistent approach of the integrated geosciences, biosciences, socio-economic and culture-historical studies in a geographic trans-border linkage with the tourism research in Gorno Altai, southern Siberia [11]. The aim is a spatial assessment of the existing geo/ecotourism resources in the Southern Altai in the frame of the territorial environmental management of the principal nature reserves and protected areas. The evaluation of the exploration tourism and recreation sustainability included cartographic, archival and literature sources, complementing the authors' own fieldwork and geo-data assembling. The field studies were carried out on the regional level as well as local scales at specific geosites following the former pilot investigations [27,59,60] and the study of the relief history [61]. The research focus was on the locations with the natural characteristics outstanding those common and broadly distributed over the East Kazakhstan landscapes. Physical characteristics associated with geosites typical of the mountain areas [62–64], along with the abiotic and biotic data defining the particular geographic locations combined with remote-sensing and photographic data were subjected to the analytical and statistical (qualitative and quantitative) processing.

A multiple landscape information system was segregated in the framework of the operation territorial units (OTU). These represent the basic spatial elements formed by single cells of regular grids (defining distribution values) of latitudes and longitudes. The shape and size of each of the defined OTU vary. The spatial dimensions of the cells' sides (from 2×2 km to 10×10 km) were determined at the region's level following the research objectives [65]. The total operating geographic coverage represented by spherical trapezes, was projected on the corresponding cartographic background map. A series of experiments and computation were conducted for an optimized definition of the influence of the geometric and topological parameters of each OTU. The system of hexagonal cells depicting geographical space of 5 km was ultimately proposed as a standard parameter with respect to the walker (excursion) availability of facilities for a one-day trip by planning perspective thematic field tours. An equivalent principle was used under the local OTU structure, according to which (in geographic interpretation), immediate surroundings of this object have the about same properties. The digitalized field data (physiographic and biotic characteristics) were analyzed according to [66] underlining the outdoor geo/ecotourism and recreational resources in the hierarchy from the nature protection areas to the natural monuments (geosites, ecosites) (Table 1).

The field record attribution to a five-grade scale was performed according to the below formula defining the territorial tourism and recreational resource capacity:

$$B_i = \frac{5(x_i - x_{\min})}{x_{\max} - x_{\min}} \quad (1)$$

The B_i index has a determinant role in the assessment of the specific type of regional tourism/recreation. The evaluation of the weighing coefficient (K) for each type of the resource expresses the tourism/recreational suitability of the particular site. In the study area, this received the highest value (1.0) defining the availability and accessibility of the main natural monuments in the broader Kazakh Altai area. A list of indexes potentially valuable for the overall research assessment of study area in terms of detail and accuracy was used as the GIS-background matrix of the evaluating factors. Each index (B'_i), expressed in points, is determined by the formula where k is the introduced weighing coefficient. A ranking of the single factors by their qualitative value and definition of the spatial characteristics was performed (B'_i). This, however, may not have a direct implication/correlation with the overall tourism potential. The generated multi-parameter geographic model enclosing the identified single geo/eco-sites defines the most perspective places for geo- and ecotourism on the investigated territory of East Kazakhstan.

The mapping of the operational territorial units of the Southern Altai natural and recreational areas, including a total of 80 cells (the selected GIS-fixed geographic sectors) characterizing the landscapes and habitats, enable to identify several most exceptional and perspective natural monuments (narrowly localized sites as well as broader regional loci). The final ranking of the specific OTU sectors documents the overall natural attractiveness defined by the climate conditions and the regionally supreme geomorphic, biodiversity and culture-historical aspects, and an overall tourism/recreation capacity of each place (Table 2). The sustainability of the specific geo/ecotourism activities at the particular sites is assessed according to the physical and human geography constituents (terrain, climate, hydrology, biodiversity, geo-therapeutic resources and archaeological finds among other variables) [67,68]. The scientific suitability of the applied methods is underlined by the straightforward categorization of the specific landscape features and interpretation of the analytical results. The field data and the regional geomorphic relief classification were completed by/referred to the formerly published studies [69].

The regional OTU analysis was complemented by the Digital Elevation Model (DEM) providing a 3-dimensional geo/eco-site distribution over the mapped territory. The QGIS 3.6 program was used to construct the present DEM spatial topographic modelling with the projection of the selected tourism and recreation loci by the Shuttle Radar Topographic Mission (SRTM) elevation data at a 1 arc-second (30 m) resolution [70]. The generated DEM maps provided the spatial (geographic) and landscape relief context and the spatial framework for the territorial exploration and leisure travel assessment (Figure 3).

Table 1. Indicators of the territorial evaluation of the geo-/ecotourism and recreation potential in the southern Altai area eastern Kazakhstan.

Indicator	Characteristics	Qualitative Scale (Points)			Weighting Coefficient
		0	1	2	
Relief	Density of linear erosion network (km/km ²)	>2.5	2.5–0.8	<0.8	1.2
	Vertical relief gradient (m)	<300	300–800	>800	1.8
	Altitude (m asl.)	0–500	500–1000	>1000	1.5
	Slope steepness (degree)	0–6	6–12	>12	1.3
Climate	Average January temperature	−25 °C	−19 °C	−9 °C	1.3
	Average July temperature (°C)	11–15 °C	16–19 °C	20–25 °C	1.7
	Average annual precipitation (mm)	600–800	400–600	300–400	1.2
	Duration of stable snow cover (days)	0–140	140–160	>160	1.3
	Duration of daily air temperature above 0 °C (days)	<160	160–190	>190	1.0
Hydrography	Coastline of water bodies (km)	absent	< 2 km	>2 km	1.0
Mineral springs	Frequency of mineral water occurrence in OTU	absent	< 1	>1	2.0
Balneology	Mud treatment occurrence	absent		present	2.0
Biodiversity	Number of landscape species within 1 OTU	0–6	6–12	>12	1.5
	Number of medical and food plants within 1 OTU	0–6	6–12	>12	1.0
	Flora listed in the Red Book (species in 1 OTU)	0–6	6–12	>12	1.3
	Number of species (fauna)	0–6	6–12	>12	1.4
	Fauna listed in the Red Book (species in 1 OTU)	0–6	6–12	>12	1.6
Geodiversity	Unique natural geosites	absent		present	0.9–1.0
Protected natural areas	Total extent (SPNA)* (% coverage area)	absent	<50%	>50%	1.1

Notes: * except for the national parks with a regulated/restricted tourism activity and development.

Table 2. The principal geotourism and geoheritage sites in the main East Kazakhstan recreational areas.

Mapped Operational Territorial Units (OTU)	Geographic Location	Weighting Factor Presence of Natural/Cultural Monuments)	$\frac{5(x_i - x_{\min})}{x_{\max} - x_{\min}}$		Geoheritage Sites (Protected Natural Areas)
			B_i	B'_i	
<i>Kurchum Natural Recreational Area</i>					
OTU55	85°07'56.0" E 48°32'07.9" N	1.0	$\frac{15}{5}$	3	Kalzhyr gorge
OTU62	84°16'42.4" E 48°16'50.3" N	1.0	$\frac{12}{3}$	4	Kalguty River confluence site
OTU39	83°33'11.4" E 48°48'21.9" N	1.0	$\frac{10}{2}$	5	Kurchum, Tabiti rock petroglyphs
OTU51	83°56'58.8" E 48°30'57.6" N	1.0	$\frac{15}{3}$	5	Moinak petroglyphs Kurchum River
OTU72	84°36'13.8" E 48°6'18.30" N	1.0	$\frac{20}{4}$	5	Kiin-Kerish & Kyzyl-Kerish badlands
<i>Katon-Karagay National Park</i>					
OTU13	85°51'16.7" E 49°30'7.2" N	1.0	$\frac{9}{3}$	3	Lake Yazovoe
OTU33	85°38'27.8" E 49°01'8.50" N	1.0	$\frac{12}{4}$	3	Katon-Karagay geo-exposition
OTU15	86°39'38.9" E 49°25'23.0" N	1.0	$\frac{15}{3}$	5	Kokkol mine Kokkol waterfall
OTU24	86°28'5.0" E 49°19'53.4" N	1.0	$\frac{10}{2}$	5	Lake Rahman
OTU34	85°56'31.3" E 48°59'27.5" N	1.0	$\frac{20}{4}$	5	Berel' Scythian royal burial mounds
<i>Markakol Natural Recreational Area</i>					
OTU 65	85°24'58.3" E 48°16'56.6" N	1.0	$\frac{9}{3}$	3	Mynshunkyr salt pits
OTU 64	84°53'48.3" E 48°21'17.6" N	1.0	$\frac{20}{5}$	4	Kalzhyr Gorge
OTU74	85°23'24.4" E 48°03'47.4" N	1.0	$\frac{20}{4}$	5	Ashutas, Black Irtysh (paleobotany and geology)
OTU46	86°2'51.2" E 48°53'11.2" N	1.0	$\frac{10}{2}$	5	Markakol Nature Reserve, Austrian road

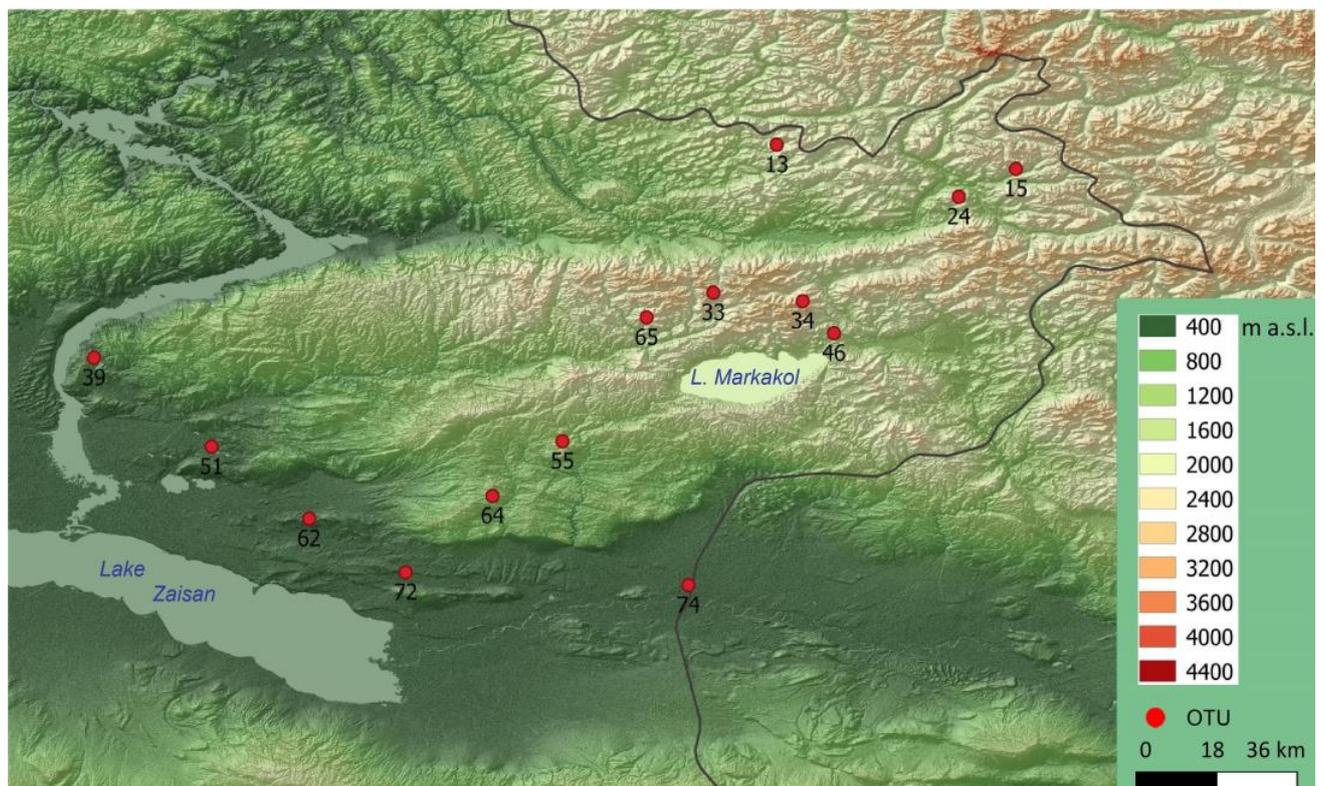


Figure 3. DEM map with projection of the most attractive tourism sites of the Southern Altai area.

4. Results

The field investigations corroborated by the analytical visualisation models show a marked differentiation of the landscape attractiveness for the geotourism development in the pristine geographical parts of the Southern Altai (Figure 3). The most exclusive sites are found in the present or the planned nature-protected recreational areas (Figure 2). Although the entire region is most appealing for the individual as well as organized travel, accessibility and availability of the local facilities are the most limiting factors. These are present just at the most attractive/principal sites close to the main roads and/or more distant places where infrastructure exists (i.e., at the administrative centres of the natural reserves and the state nature parks). In terms of a closer spatial multi-proxy evaluation of the most interesting loci, several new natural and cultural sites have been identified, the latter in combination with distinctive geomorphic settings. Some of these have already become frequented by domestic tourists and other visitors contributing to the overall recreation increase of the region during the last years (2015–2020). This trend reflects the improved communication network as well as the national tourism medialization and state promotion. The linked concept of geotourism and ecotourism combined with cultural tourism represents in unity the most perspective visitors' travel branch.

The tourism/recreation sites of the highest significance cluster on the model maps in the present protected areas on the territory of the Southern Altai—the Katon-Karagay State Nature Park and the Late Markakol Nature Reserve (Figures 1, 4 and 5; Table 2). Many most interesting geosites are associated with unique archaeological sites (prehistoric cemeteries, kurgan tombs, rock-art with petroglyphs) [21] as well as the palaeontological monuments (the Kiin-Kerish and Kyzyl-Kerish canyons) found along the Kurchum River within the Kazakh–Xinjiang border zone. The areas with the major geo/ecotourism attractiveness also show the widest relief diversity and biodiversity (Figure 4, Table 3).

4.1. The Katon-Karagay Area

The Katon-Karagay recreational area occupies about 30% of the Katon-Karagay State Nature Park/KKSNP (6435 km²) being the largest and most recently (2001) established NP in Kazakhstan. Except for the recreation sector, the NP includes the sector of economic development and the strictly protected nature reserve closed to general public and visitors. There are many distinctive geomorphic locations as well as cultural sites found on the territory of the KKSNP that gained attention and received an international status as a part of the trans-border Great Altai-Sayan Eco-Region [71,72].

The principal geosites include the Altai highest peak the Belukha Mt. (4506 m asl.) of the Katun' Range (Figure 6a), the Kokkol waterfall (56 m-high), one of the highest in the Altai; the mountain lakes Yazovoye and Arasan, the Rakhmanovskiye Klyuchi hot springs (1760 m asl.) (Figure 6b), the molybdenum-tungsten Kokkol mine (a former gulag of the 1930–1940s) at the Kokol pass (2950 m asl.) and the Berel' "royal" Scythian cemetery [73,74]. The Belukha Mt. is the traditional destination for alpinism and an extreme mountain trekking. The Rakhmanovskiye mineral springs located on the NE side of the Rakhmanovskoye Lake (1.14 km²) shore is one of the most frequented places of the Altai, primarily because of the balneology spa used for natural therapy. Historic data mention a Buddhist joss-house located near the lake. The local hydro-calcium carbonate hot springs enriched of radioactive radon originate in granitic and shale bedrock joints with emanating temperature of 340–430 °C. The supreme mountain scenery of the surrounding peaks (4000 m asl.) is underlined by the cascade waterfalls falling from Lake Arasan (1734 m asl.) into Lake Yazovoye drained by the buoyant Belaya Berel' River. The Rakmanovskiy waterfall is one of most prominent geo-sites located in the southern Siberian taiga phyto-reserve. The aesthetic value of this spot connected just by a gravelly road to Yazovoye village that provides a year-round access and local accommodation facilities. In view to the landscapes' beauty, the prospects for geotourism and ecotourism oriented activities in the Katon-Karagay Recreational Area are very good [27].

4.2. The Lake Markakol Area

The picturesque Lake Markakol located at 1485 m asl. in the rifted tectonic basin drained by the Kaldghir River is the largest alpine lake in Kazakhstan (Figure 6c). The eponymous Markakol Nature Reserve (founded in 1978) owns its highest protection status to the extraordinary biotic life, including several endemic species of fish, birds and flora (both aquatic and terrestrial) [75,76]. From the north, the lake closes to the E-W oriented Sarym-Sakty Range (3373 m asl.) and the Kurchum Range (2645 m asl.); from the south the lake is aligned by the Azutau Range (1800–2300 m asl.). The geomorphic setting of the basin (size 38 × 18 km, maximum depth 27 m) indicates a tectonic (Cainozoic) origin with a steep southern margin and a shallower northern shore formed by Late Pleistocene deglaciation alluvia [20] (Figure 6d). The surrounding landscapes are covered by the Siberian larch (*Larix sibirica*) forests with mixed (spruce-fir-aspen) taiga spreading over the more humid northern slopes contrasting with the arid southern rocky exposures with just scanty, semi-dry bushes and xerophytic grasses.

Although the size of the nature reserve (75,048 ha) is just about 1/9 of the territory of the KKNP, this plays a key role for the regional geodiversity and biodiversity conservation. The reserve is protected by an adjoining buffer zone encompassing a total 2221 ha. The eastern (recreational) lake shore (1500 ha) has several fishing and sport facilities. There is still a low awareness of the geomorphic setting alone. In spite of the utmost natural beauty, only 2000–3000 visitors come to the reserve yearly, mainly in summer and early fall, partly because of the milder and more humid micro-climate contrasting with the open windy parkland-steppes of the eastern Kazakhstan geographical province.

4.3. The Kurchum Area

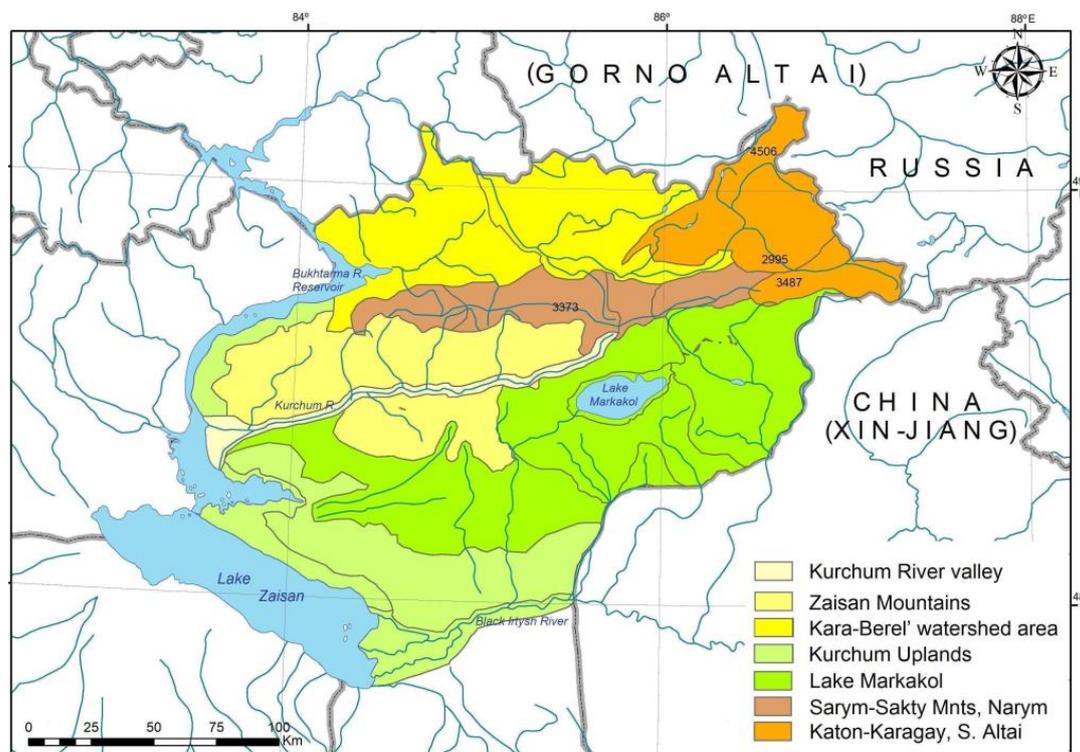
The Kurchum area bordered by the Lake Zaisan and the Bukhtarma River (Figure 1, Figure 6f) is endowed by the most diverse geo-relief and vegetation types found in East Kazakhstan. The semi-desert with deflated rocky surface along the Zaisan Lake grading into the sediment-accumulative eastern zone of the Kurchum District with imposing sand dune fields, the Mramornaya Mt. built of pure and highly aesthetic multicoloured marble, together with the isolated salty lakes are just some of the principal geosites.

The colourful Kiin-Kirish badlands canyon with ancient Mesozoic (dinosaur-time) petrified palaeontological fossil findings (Figure 6e), together with the Ashutas geological monument famous for palaeo-botany (fossil macro-flora) records are the geomorphic and palaeontological highlights adding to the overall geoheritage values of the region [77]. The Mynshunkyr (“thousand holes”) salt springs, situated near the Kalghyr village and traditionally venerated by the local people, have a long exploitation and use history. The sodium-rich mud (150 mil. year-old clayey deposit) is proven to have unique medical and healing properties. Every summer (June–August), inhabitants of the surrounding rural communities, as well as casual visitors, apply the mud for various medical (mainly skin) treatments in addition to Na⁺-permineralized water drinking as a prophylactics against gastric, kidney and hepatic diseases. Field investigations and analyses confirmed sufficient deposit reserves for future exploitation [68].

Mysterious archaeological monuments hidden in the landscape (rock art sites, decorated stone steles and prehistoric burial mound complexes) along with early historical places distributed across this picturesque land disclose the existence of numerous ancient (Bronze and Iron Age) cultures and the medieval civilizations documenting the sequenced occupation of the region located along the northern Silk Road [78]. These sacred and cultural sites represent an integral part of the regional geoheritage [21,79]. The Kurchum area together with the nearby Kalba Highlands and the Tarbagatai Range host diverse gemstone occurrences of precious, semi-precious and decorative stones (including topaz, sapphires, emeralds, tourmalines, jasper and other) used and traded since the ancient times, and documented by the findings of cut-stones of the regional geographic provenance excavated in the Altai “royal” burial mounds sites [16,80,81].

Table 3. Geographic recreation areas/sectors and the corresponding geo/ecosystems of the Southern Altai region.

Geographic Recreation Area	Altitude (m asl.)	Geomorphic Settings	Geology	Soil Cover	Vegetation/Biotopes
Kurchum R. Valley	700–1500	Alluvial plain River delta Fluvial terraces	Fluvial deposits Slope colluvia (sandy-gravels)	Chestnut soils Luvisols	Parklands Coniferous taiga Xerophytic shrubs
Zaisan Mountains	200–500	Low-elevation hills Intermontane plain Alluvial fans	Sedimentary Metamorphic bedrock	Brunisols Solonchaks Solonets	Mixed taiga Xerophytic salt-adapted plants
Kara-Berel' Watershed Area	2000–3850	High-elevation mnt and rocky foothill denudations, loess	Igneous Metamorphic Sedimentary form.	Regosols Brunisols Chernozems	(Sub-)alpine meadows Coniferous taiga Parklands
Kurchum Uplands	500–700	Mid-elevation hills Deflation surfaces Sand-dune fields	Metamorphic Sedimentary form. quartzite, sandstone	Brunisols Podzols Regosols	Coniferous taiga (larch-spruce-fir) Semi-desert steppe
Lake Markakol	1000–1500	Mid-elevation mnts Tectonic depression Erosional valleys	Metamorphic Sedimentary form (quartz, limestone)	Podzols Brunisols Chestnut soils	Coniferous taiga (larch-spruce-fir) Mixed shrub-.taiga
Sarym-Sakty Mnts Narym Plateau	2000–3500	High mountains Orogenic plateau Palaeo-glacial relief	Metamorphic Igneous (gneiss, granite)	Brunisols Podzols Regosols	Xeric fescue-steppe Alpine meadows Shrubs (larch-spruce)
Katon-Karagay NP (Southern Altai)	1500–4500	High mountains Glacial landscape Gravity deposits	Metamorphic Igneous (granite, gabbro)	Brunisols Podzols Regosols	Dark coniferous taiga Shrubs (birch, willow) Alpine meadow, tundra

**Figure 4.** Spatial projection of the principal geographic recreation areas of the Southern Altai territory.

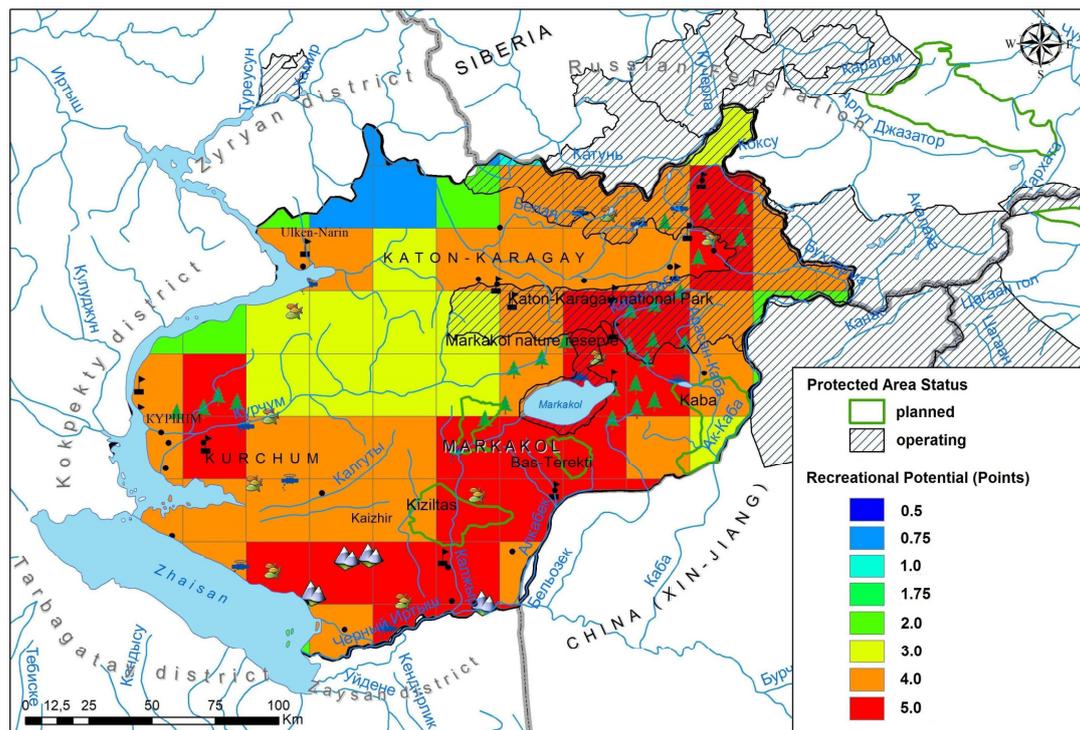


Figure 5. Generated model map of the geo/ecotourism potential and the recreation attractiveness in the Southern Altai area.

5. Discussion: The Altai Geo- and Eco-Tourism Sustainability and Perspectives

The Southern Altai area is with respect to the wide array of scenic landscapes and numerous geosites, reflecting the complex regional geological history and relief-shaping processes, the most attractive tourism and rural recreation region of East Kazakhstan [5]. This part of the country is also becoming the main destination for the exploration and educative geotourism, as well as specialized cognitive ecotourism and nature-protection activities. The complex analysis of the integrated geological and geomorphological data completed by the biotic and cultural records, personal experience and knowledge from reconnaissance expeditions and study trips confirm the major potential of the territory for the sustainable rural tourism and the national as well as international travel.

The principal assets and the investment-free predispositions of the three specified recreation areas are: (1) arid landscape openness, (2) broad relief diversity and visibility, and (3) pristine nature with a minimal anthropogenic impact. Largely analogous natural predispositions used to exist in the presently greatly travelled European Alps a few hundred years ago, for example. The presently available visitors' local facilities, however, approach from far the standards found in other alpine resorts around the World. Accessibility and accommodation are the main limiting factors for international tourism (in a broader sense) and remain as the key travel operation-base pre-requisites.

The pristine natural resources of the Altai Mountains are considered as the main drivers for the modern geo- and ecotourism development. Except for the relief diversity, the broader geographic region is rich in elsewhere rare flora and fauna with a very high level of species endemism [27,82]. Plentiful medicinal herbs, such as sand thorn (*Hippophaë rhamnoides* L.), rose/golden root (*Rhodiola rosea* L.) maral root (*Rhaponticum carthamoides* Wild.), are used in the traditional medicine of the Altai and Kazakh people, and in the pharmaceutical industry [83]. There are >400 bird and >60 mammal species registered. Snow leopard (*Irbis*) is the dominant predator on top of the mountain fauna food chain. Except for the landscapes and biota, the region has pleasant continental climatic conditions. Rather than the impact of the perspective tourism alone, a very acute issue is the environmental effect of the present global climate change to the Altai alpine ecosystems observed also in other high-mountain regions around the World [84–86].



Figure 6. The Southern Altai landscapes and geosites. (a) the Katun' Range (4506 m asl.), (b) Rakhmanovskiye Klyuchi Lake (1750 m asl.); (c) Lake Markakol (1485 m asl) at the foots of the Sarym-Sakty Range (3373 m asl.); (d) a rural mountain setting, Urumkhaika—a typical rural village in the study area with a Late Pleistocene glaciofluvial terrace in the background (Lake Markakol Nature Reserve; (e) the Kiin-Kerish Mesozoic badlands; (f) arid rocky landscape flooded by the Burkhtarma Reservoir; (a,b) the Katon-Karagay recreational area; (c,d) the Lake Markakol recreational area; (e,f) the Kurchum recreational area (photographs by Jiri Chlachula).

The multi-faceted (geo/eco) nature of the principal tourism and recreation areas identified by the bio-geographic model analysis offers a broad range of visitors' activities. These include stationary leisure-time stays with casual sight-seeing excursions to extreme sports including alpinism, rafting, kayaking and paragliding. The natural and major artificial lakes (Lake Zaisan and the Bukhtarma Reservoir, respectively) (Figure 6f) provide nice beaches and scenic bays along the several hundred kilometres-long shores fitted for swimming, yachting and fishing. In winter, the snow-covered mountain countryside offers best conditions for cross-country skiing and wildlife observation. Year-around, geo- and ecotourism trips can be organized to enjoy the great geomorphic and biotic (flora and fauna) variety concentrated in this marginal Kazakh–Russian–Chinese border-zone territory [29]. These trips can be combined with the specialized local history and ethnology traveller's visits to the traditional Kazakh rural settlements (Figure 6d).

The research results allow proposing specialized and multi-thematic itineraries connecting the main natural and cultural attractions of the principal recreation areas for international and national tourists, as well as for educative and cognitive field programs, and research trips for professionals (geographers, geologists, gemmologists, biologists, archaeologists). The time of visits is predetermined by seasonality with year-round possibilities for nature observation. Late-spring to early-fall is the best time for general travel and recreation. The nearest airport (Ust'-Kamenogorsk) lies in a reasonable distance to the regional district centers (212 km to Kurchum; 330 km to Katon-Karagay) with an aerial connection to Zaisan (1-h flight). The local villages within the travelled area, offering regular or casual accommodation facilities and the visitor centers, are in a sound reach (20–50 km). The quality of accommodation and the individual touristic services may differ significantly depending on the particular tour operators.

Currently, there are no major conflicts between the tourism entrepreneurs and the administration of the protected nature reserves/national parks, primarily because of the limited operations. Yet, in the near absence of the tourism-oriented environmental management, this situation may change. A long-term strategy for the control of expanding regional recreation activities and the regular assessment of their feedbacks on the exposed (most frequented) landforms (geosites), ecosystems and habitats is necessary [27,87]. Certain negative effects of the formerly strictly closed border-zone subjected to the limited entry regime now opening to an uncontrolled and spontaneous tourism has been observed in the certain challenge in the mentality of the local people adopting a market-oriented attitude seen in the steadily rising costs for accommodation and transport. Resort-development interviews generally receive an overall positive reaction among the locals (community response), especially of the tourism-business stakeholders.

The well-organized nature-based geo/ecotourism and a proper organization of the tourism space may eventually play an important role in the sustainable socioeconomic planning balanced by the regional administration of this peripheral and largely undeveloped mountain region. At the same time, precautions should be taken to prevent or at least to reduce the undesirable consequence of the commercial tourism expansion which may generate a degrading cultural change among the Altai pastoral communities in spite of the economic benefits. A social impact of the tourism industry must thus be a priori considered while setting up the main stationery regional recreation facilities.

The current studies show an increasing interest in tourism research and tourism management in Kazakhstan [88] and the neighbouring Russian Altai [89]. Landscape mapping and relief protection are concomitant with the national geotourism promotion. A successful modern-style geotourism inauguration presumes a professional field-based research and knowledge, along with the active involvement of the Kazakh regional authorities (*akimats*) and training of the locals to acquire the new employment skills. This trend, seen during the last years, is evident in the "society-friendly" mountain recreation managed in the Russian Gorno Altai [11,90]. Innovative spatial documenting of unique geological/geomorphic sites enables the establishment of regional geotourism and adds to a better public consciousness of the national geoheritage values and their importance.

6. Conclusions

The present study defined the principal places for the shared geo- and ecotourism on the broader Southern Altai territory representing, along with the Tian-Shan Mountains, physiographically the most varied geographical region of the Republic of Kazakhstan. In spite of the landscape diversity and the foremost natural beauty, the identified tourism and recreation areas are still rather marginally opened to visitors by comparing to the Russian Gorno and the Xinjiang Altai. The geo-biographic model of the travel and recreation potential provides a useful tool for installation of the modern geotourism and ecotourism in this picturesque and as yet undiscovered part of Central Asia. The complex research approach is essential for holistic comprehension and learning about the country, its history and the present development as a part of free-time activities and education. The territorial assessment of the most perspective and vital recreation zones contributes to the management of the nature protected areas of East Kazakhstan. “Wild” tourism brings negative effects and undesirable consequences to the pristine lands, harm to geoheritage and cultural heritage, as well as adverse challenges in the traditional rural lifestyles. Absence of regulatory measures may threaten the sustainability of the tourism and recreation sector in some more frequented and tourism-exposed locations. The desired state support of the organized nature-friendly free-time activities will, on the contrary, contribute to the diversification of the regional development with the implementation of an effective environmental strategy, and foster the infrastructure investments. The present climate-change feedback, most prominent in the high-mountain and alpine zones of Asia, and triggering the major ecosystem transformations and geo-hazards, may generate on larger scales more acute problems to the montane landscapes and the stability of the biotically diverse, yet most fragile habitats than the local, spatially limited tourism activity and the visitors’ site-centred behaviour and environmental interactions. A modern geo/ecotourism-oriented administration policy complying with geoheritage concepts integrated into the traditional Kazakh cultural milieu is fundamental.

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