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Arid landscapes of the Central Asian region

Abstract. *The large absolute heights, the complex geological and orographic structure of Kyrgyzstan and Kazakhstan, their geographical position in the depths of the Eurasian continent, surrounded by vast deserts and the related continental and arid climate, create a great diversity of landscapes, a variety of natural conditions. By the totality of natural factors, taking into account their spatial differences, the structure of the altitudinal zonality of landscapes, the territory of the two countries is a complex system of geocomplexes of different ranks. Geocomplexes of Central Kazakhstan belong to the arid system and are developing under the conditions of manifestation of natural and technogenic processes. According to the peculiarities of geological and geomorphological differentiation of the territory, depending on local physiographic conditions and processes, landscapes are distinguished relative to the lowered accumulative plains, elevated denudation plains, small hills and island lowlands.*

Keywords: *Landscape, geo complex, desertification, arid landscapes, Kyrgyzstan, Kazakhstan, province, district.*

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Introduction. One of the fundamental concepts of modern geography is landscape. It is based on the idea of the relationship and interdependence of all the natural phenomena of the earth's surface. The landscape, representing an organized system, must have a certain structure, which is considered both vertically and horizontally. The vertical structure is expressed in its longline structure, in the ordered arrangement of the components. The horizontal, or morphological, structure is expressed in the mutual arrangement of subordinate local geosystems and how to connect them. The landscape is constantly changing. Some changes are reversible, cyclical and do not lead to a transformation of the landscape structure. We gave seasonal rhythms as an example. In most landscapes, the appearance and all functioning processes change seasonally. Being an object of active and diverse in the forms of economic development, arid landscapes are complex transformational links with the parallel development of multidirectional processes: improvement of water cut conditions as a result of the gradual expansion of the irrigated agriculture zone, regulation of river flow and the development of desertification processes over vast territories [1].

The arid landscapes of Kazakhstan and Kyrgyzstan are very diverse, due to the absolute heights, complexity of the geological and geomorphological structure, and location in the depths of the mainland. Continental and arid climate, the presence of vast deserts, altitudinal zonation created a complex system of geo complexes of various rank. Despite the similarity of the natural conditions of

Kazakhstan and Kyrgyzstan, there are differencesin types of landscapes, in the schemes of physical and geographical zoning.

Research methods. There are several schemes of physical-geographical zoning of Kyrgyzstan. According to one of them, Kyrgyzstan is located within three large physical and geographical countries - the Central Asian lowland, Central Asian mountainous and Central Asian highlands. Countries are divided into 6 natural geographical areas and zones, 10 provinces, 28 districts and 75 physical and geographical areas [2].

The Central Asian plain country covers in the north of Kyrgyzstan the Chuy (up to 850-900 m) and Talas (up to 700-800 m) valleys, and in the south - the foothill inclined plains of the Fergana region (up to 1000-1100 m), occupying the lowest hypsometric position in the republic and forming, respectively, the Chu-Talas and Ferghana provinces, with a total area of about 7,800 km2. The provincial relief is flat, weakly wavy accumulative and consists of loess-pebble plains and plumes of cones of removal of foothill plains and low adyrs, composed of Quaternary and Upper Neogene alluvial and proluvial sediments, and dissected by numerous transit rivers, sai and irrigation canals. The climate is continental, arid, with very warm summers, moderately mild winters, and low rainfall. Soils are gray-earth with ephemeral vegetation. Landscapes of the provinces in their natural state belonged mainly to the desert and semi-desert types.

Chu-Talas province, according to the geographical position and nature of the landscape, is included in the northern zone of the temperate deserts. It is subdivided into Chui and Talas districts. Chui district occupies almost the entire flat part of the eponymous valley of Northern Kyrgyzstan from 530 to 850-900 m abs. heights. In morphogenetic terms, it represents the newest (East Chuy) intermontane depression superimposed on the Paleozoic base and filled with thick (up to 3.5-4 km) strata of Meso-Cenozoic deposits rich in groundwater and forming the East Chuy artesian basin. Geological water reserves are estimated at 146.14 billion m3. According to seismicity, the territory of the okrug is 8-point, and its southern part is 9-point earthquake zones.

The relief of the okrug is a tectonic-erosive-accumulative undulating plain, formed in Quaternary on ancient alluvial and alluvial-proluvial deposits. According to morphological features, the relief is divided into 4 types: floodplain-terrace plain, elongated along the Chu River and its left tributaries; terrace-remnant, flat-plateau, located in the northern part of the district; piedmont-flat, slightly inclined, dissected, occupying the central part of the district; wavy-flat, steeply inclined, foothill-plume, stretching at the foot of the Kyrgyz Ala-Too.

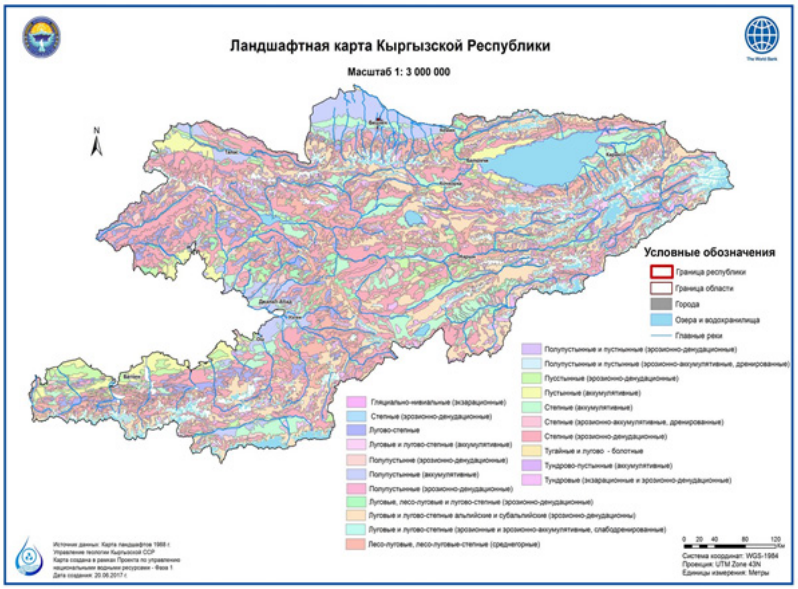

Figure 1. Modern landscapes of Kyrgyzstan [3].

Modern changes in the structure of landscapes occur mainly under the influence of endogenous relief-forming processes and anthropogenic activity. Landscapes of Kyrgyzstan were formed against the background of the high seismic activity of its territory. Active uplift of ridges continues at the present time, as a result of which the lithogenic basis of landscapes is constantly being rebuilt, and the natural complexes themselves are characterized by dynamism. The processes of gravitational drift and erosion, glacial activity, avalanches, mudflows, landslides and landslides, combined with seismic activity, cause continuous reconstruction. The active movement of matter and energy arising under the influence of endogenous processes combines natural complexes into functional dynamic systems - slopes and bottoms. Within the manifestation of these processes, zones of their nucleation, transit of matter and its accumulation are distinguished. Correspondingly, landscapes are distinguished that are dynamic due to their position in the zone of origin of the foci of many processes (highland nival and subnival), transit (sloping forest, meadow, steppe), accumulations (foothill, intermontane-hollow, semi-desert and desert) [3].Peculiarities of morphotectonic signs and manifestations of latitudinal, longitudinal and altitudinal differentiation make it possible to classify all the landscapes of the territory as mountainous with subclasses: alpine, mid-mountain, foothill-low-mountain, mountain-valley and intermontane-hollow. The first three subclasses relate to the landscapes of mountain slopes, which are characterized by upward movements of the lithogenic base, the predominance of drift processes, surface bedding of bedrock, a large variety associated with isolation and circulation exposure, as well as the degree of dissection of the relief. The second group of landscapes (lower parts of mountain valleys and the bottoms of intermountain basins) is formed mainly by tectonic subsidence on thick accumulative deposits. They are characterized by less variety and fragmentation of differentiation.

At altitudes of more than 3200-3500 m, the mountain-rock-nival type of landscape is widespread, where the average July temperature ranges from 0-5° C. It occupies up to 15% of the republic's area, where numerous glaciers and firn fields are located, there is no soil and vegetation cover on rocky ridges, processes of frosty and physical weathering predominate.

Syrt landscapes are represented by high-mountain steppe, desert-steppe, tundra types (Inner and Central Tien Shan), are formed at absolute heights of 3000-3600 m on the syrtic accumulative weakly wavy plains, in places with preserved moraine relief. These plains are covered with boulder-pebble and loamy deposits. Dry climate, low temperatures and poor drainage of the surface determine the pronounced complexity of the soil and vegetation cover and the presence of salt marshes in the complexes. The alpine cold desert is located at absolute heights of 3600-3900 m (Inner and Central Tien Shan), where 200 to 300 mm of precipitation falls, mainly in solid form, average January temperatures - 21.2 °, July - 4.7 ° C . The originality of these deserts is emphasized by the presence of permafrost, the proximity of modern glaciers, and the widespread development of cryogenic processes. These landscapes occupy the tops and slopes of syrt ridges, moraine hills, their distinguishing feature is the desert, which manifests itself in the properties of soil formations and in particular the vegetation cover, represented mainly by pillow-shaped shrubby xerophytes, and a complex of takyrnd carbonate, in places saline soils. The territory is mainly used as summer pasture.

Polygonal rocky tundra are located on the denudation plains preserved from erosion (3900-4300 m). These landscapes are characterized by the widespread development of ancient glacial exational and accumulative forms, a wide manifestation of frost weathering, the proximity of glaciers, and large amplitudes of diurnal temperatures. This type of landscape is distributed in small spots on all the high ridges of the Tien Shan; the most typical sections of the tundra are in the Inner and Central Tien Shan. Here, polygonal takyr-like thin and highly gravelly soils are formed, the vegetation is very sparse, represented by lichens, mosses, single specimens of dryadots, Smelovsky, Richeria and Saxifraga [4].

The landscapes of the mountain slopes are used mainly as pastures and in forestry, intermountain depressions - for the most part they are suitable for agriculture and horticulture and are largely converted into cultural landscapes.

Geocomplexes of Central Kazakhstan belong to the arid system and are developing under the conditions of manifestation of natural and technogenic processes. According to the peculiarities of geological and geomorphological differentiation of the territory, depending on local physiographic conditions and processes, landscapes are distinguished relative to the lowered accumulative plains, elevated denudation plains, small hills and island lowlands. Among the landscapes, relatively lowered accumulative plains, steppe and dry-steppe prevail. In tectonic terms, they are confined to the Karaganda, Maykyubinsky and Tengiz depressions. Landscapes of relatively elevated denudation plains formed on the effusive sedimentary rocks of the Paleozoic and are dry-steppe and semi-desert geosystems. They are the dominant landscapes of the Kazakh shield. At a higher hypsometric level, small-hilly landscapes of forest-steppe, steppe and semi-desert geosystems on metamorphic, effusive-sedimentary rocks of Precambrian and Paleozoic are developed [1, p. 27].

Figure 2. Heaps of the Karaganda coal basin. Photo by Akpambetova K.M.

In the areas of mining development, the most significant landscape changes occur. In these areas, new natural-technical systems were formed under the conditions of a significant change in the geological environment with technogenic relief forms: dumps, quarries, heaps, etc. The thickness of the dumps reaches 50-100 m, heaps - 60-80 m. Landscapes with mining enterprises located within them are characterized by increased air pollution due to the development of a fine-grained component of gangue. Since the beginning of the 70s, measures have been taken in Karaganda for the utilization of coal production, including extinguishing and the subsequent elimination of waste heaps. As a result of such work carried out by the coal department, heaps ceased to smoke. The intensification of denudation processes contributed to the formation of powerful foci of dusting. The denudation of overburden in dumps, heaps, near mines and quarries, the subsequent migration of the chemical compounds contained in them with the formation of secondary scattering rheoles is also an integral part of techno genesis. Erosion processes, as a result of which vast areas are disabled, contribute to the accumulation of accumulative material at the foot of the slopes. On the territory of the city there are several dumps of considerable size, polluting the environment of both the area in which they are located and the city as a whole. On such dumps, overburden is sprinkled in several tiers with a height of more than 20 m. The resulting artificial relief, consisting of high embankments and shallow depressions, has a rugged surface. The slopes of the dumps are excised with ravines (Fig. 3).

Figure 3. Terraced surface folded by waste rock. On the slopes - manifestations of stream erosion. Photo by Akpambetova K.M.

Technogenic changes in natural complexes also occur during hydraulic construction. The construction of the Irtysh-Karaganda canal was started in 1962, the operation was launched in 1968. In 2002, a water conduit was built into the Esil (Ishim) river, and then to the Vyacheslav reservoir for the water supply of the capital of Kazakhstan, Nur-Sultan. The channel is 458 km long, 20-40 m wide, and 5-7 m deep. The canal crosses the river. The Nuru runs along the Duker and ends at the pumping station of the 1st lift of water canal OJSC in Karaganda. The length of the channel in the Karaganda region is 186 km, in the Pavlodar region - 272 km. The main structures of the Irtysh-Karaganda canal are 22 lifting pumping stations (water rises 418 m), 14 reservoirs and 34 canals located on the sites. In addition, there are 39 engineering structures on the highway. These are water outlets, spillways, dukers, drainage pipes, bridges.

The main technogenic impact on the terrain is made during the construction of the canal, and later on as a result of the operation. In addition, China's withdrawal of water from the Black Irtysh River in the amount of 2 km3 / year (in the future 4 km3 / year) will lead to the impoverishment of the Irtysh water resources. Considering the fact that the water resources of the Black Irtysh in China are not large: the average long-term runoff at the confluence of Lake Zaysan is 9 km3 / year (10% of the runoff of the Irtysh at its confluence with the Ob), then weaning 2 km3 / year will be 20-25 % of annual runoff, and 4 km3 / year - more than 40% of annual runoff. In the context of incomplete construction of the Shulba hydroelectric facility, the river will become shallow, the water level will decrease by 0.63 m in the Pavlodar site, and by 1.1 m in the Omsk site. Water intake conditions from the Irtysh pump stations of municipal and industrial enterprises of cities and towns will deteriorate, including including the Irtysh-Karaganda canal [5].Conclusions. Thus, the development of mineral deposits, primarily coal, the artificial leveling of the relief for the purpose of building roads, the presence of quarries and pits without their subsequent reclamation, the flooding of the relief with mine water, the presence of closed mines without their subsequent restoration, the presence of empty dumps rocks lead to waterlogging, flooding and subsidence of most of the geocomplex relief. Changes in the landscapes of Kyrgyzstan and Kazakhstan (Central Kazakhstan) occur under the influence of endogenous processes and anthropogenic load. To prevent the negative consequences of anthropogenic impact, it is necessary to develop a landscape and ecological forecast taking into account the regional characteristics of the territory, and to apply measures for the protection and rational use of natural resources.

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Орталық Азия аймағының аридті ландшафттары

Аңдатпа. Қырғызстан мен Қазақстанның үлкен абсолюттік биіктіктері, күрделі геологиялық және орографиялық құрылымы, олардың кең шөлдермен және онымен байланысты континенталды және құрғақ климатпен қоршалған Еуразия материгінің тереңдігіндегі орналасуы, ландшафттардың алуан түрлілігін және түрлі табиғи жағдайларды тудырады. Табиғи факторлардың жиынтығы бойынша олардың кеңістіктік айырмашылықтарын, ландшафттардың биіктік зоналылығының құрылымын ескерілді, екі елдің аумағы әртүрлі деңгейдегі геокешендерінің күрделі жүйесі болып табылады. Орталық Қазақстанның геокешендері құрғақ жүйеге жатады және табиғи мен техногендік процестердің көрінісі жағдайында дамиды. Аумақтың геологиялық және геоморфологиялық дифференциациясының ерекшеліктеріне сәйкес жергілікті физикалық-географиялық жағдайларға және процестерге байланысты ландшафттар төмен түсірілген аккумуляциялық жазықтарға, денудациялық жазықтықтарға, ұсақ төбешіктер мен арал жазықтарына қатысты ерекшеленеді.

Түйін сөздер: ландшафт, геокешен, шөлейттену, арид ландшафттар, Қырғызстан, Қазақстан, провинция, округ, аудан.

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Аридные ландшафты Центрально-Азиатского региона

Аннотация: Большие абсолютные высоты, сложное геологическое и орографическое строение Кыргызстана и Казахстана, ихгеографическое положение в глубине Евразиатского материка, в окружении обширных пустынь и связанная с ними континентальность и засушливость климата, создают большую пестроту ландшафтов, разнообразие природных условий. По совокупности природных факторов, с учётом их пространственных различий, структуры высотной поясности ландшафтов, территориядвух стран представляет собой сложную систему геокомплексов разного ранга. Геокомплексы Центрального Казахстана относятся к системе аридных и развиваются в условиях проявления природных и техногенных процессов. По особенностям геолого-геоморфологической дифференциации территории в зависимости от местных физико-географических условий и процессов выделяются ландшафты относительно опущенных аккумулятивных равнин, приподнятых денудационных равнин, мелкосопочника и островных низкогорий.

Ключевые слова: Ландшафт, геокомплекс, опустынивание, аридные ландшафты, Кыргызстан, Казахстан, провинция, округ, район.

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