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Landscaping features of the Burabay district of the Akmola region

Abstract. *The scientific work describes the applicability of geoinformation technologies in landscape analysis, including the study of natural components through remote sensing. The focus of the work is shifted to the use of various sources of remote sensing information, the transfer, and processing of the information obtained with their further use in the analysis of landscapes and their components. Based on the results of the study of the poster and stock materials, the characteristics of the landscapes of the Burabay district of the Akmola region are given. The results obtained can be used to solve spatial problems and deepen knowledge in the study of the components of the natural environment, as well as the study of the anthropogenic load of the territory.*

Keywords: *landscape, landscape analysis, GIS technology.*

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Introduction

Landscape maps are graphical results of studying natural-territorial complexes - landscapes of different categories and any taxonomic rank. Natural-territorial complexes (NTC) are complex dynamic systems with many direct and reverse connections between parts of the complex and the environment. The study of landscape maps allows you to get an idea of the factors and patterns of spatial differentiation of the natural environment, genetic and dynamic relationships of geosystems. Landscape maps are necessary for solving many problems of science and space. More and more, such cards are involved in the work of environmental protection [1]. The term "landscape" is non-taxonomic. Landscapes are characterized by vertical, horizontal, and temporal structures with dynamics (changes) of geographic complexes. Landscapes of different levels, differing in the degree of complexity of the internal structure and spatio-temporal scales, have their own special functional and evolutionary-dynamic patterns [2].

Regional landscape-geographical research does not end with the compilation of landscape maps, but a new stage of scientific research begins. They act as initial models for physical-geographical zoning, cartometric and cartographic-mathematical analysis of landscape structures, possible applied land assessments, expert reviews of economic projects, regional planning, forecasting constructions, etc. [3].

New methods of mapping, primarily using satellite imagery and GIS technologies, have changed the generally accepted mapping technology.

Territory and research methods

For landscape research, we took the Burabay district of the Akmola region. In the Burabay district of the Akmola region, there is the Burabay State National Park. It is considered to be the main natural attraction. The forestry was created in the village to preserve the nature of this region in 1898. Since 1935, the reserve, covering an area of 130 km², included lakes and forests that surrounded the village. In 1951, forestry was abolished. After 49 years, the leadership of Kazakhstan decided to transform the

territory of the former forestry into a national park [4].

Now there are 14 lakes, where tourists can go fishing. The lakes are equipped for beach recreation. The gentle descent to the river is perfect for families with children. In winter, the central part of the park becomes a place for alpine skiing.

This area is called Kazakhstani Switzerland because of the majestic mountains and nature of striking beauty. People come here to restore the respiratory system, test the theory of kumis treatment and enjoy the magnificent landscapes to their fullest. Burabay is an amazing place: among the yellow lifeless steppes, there is a real oasis, surrounded by mountains and dense coniferous-deciduous forest. Also on the territory of the village, there are 14 reservoirs with clean water and an abundance of fish. The main one is Lake Borovoe, a natural reserve with sandy and stone shores and clear water [5].

Burabay district is located in the north of the Akmola region, east of the regional center Kokshetau. It borders in the north with the North Kazakhstan region (Figure 1).

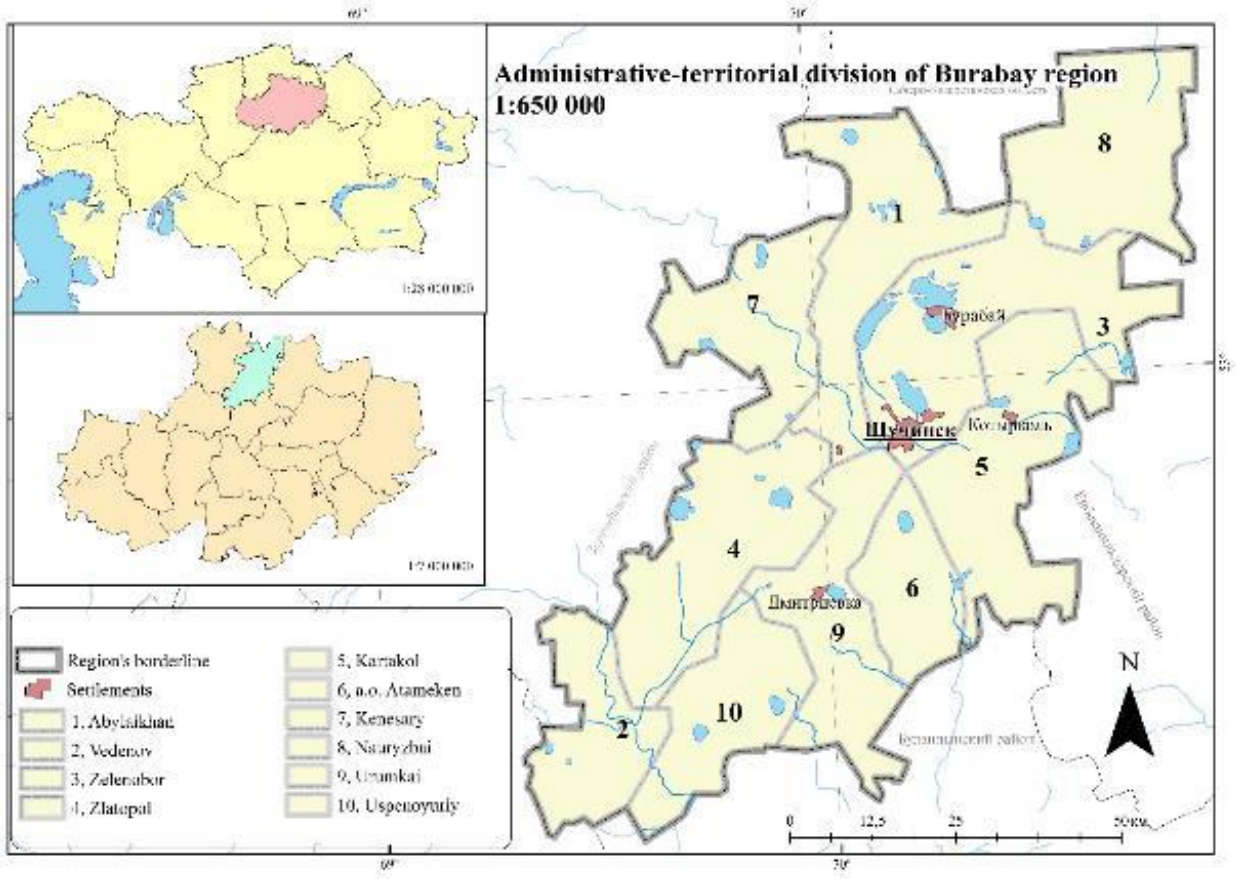

Figure 1. Map of the location of the Burabay region

The climate of the Burabay district of the Akmola region is sharply continental, the average annual air temperature is 17˚C. The intra-annual variation of air temperature is characterized by persistent severe frosts in winter, an intense increase in heat in the short spring season, and heat during the summer. The average air temperature in January is -13 ˚C, in some years it reaches -40 ˚C, in summer the average temperature is 19.2 ˚C, maximum up to + 41.6 C (Figure 2).

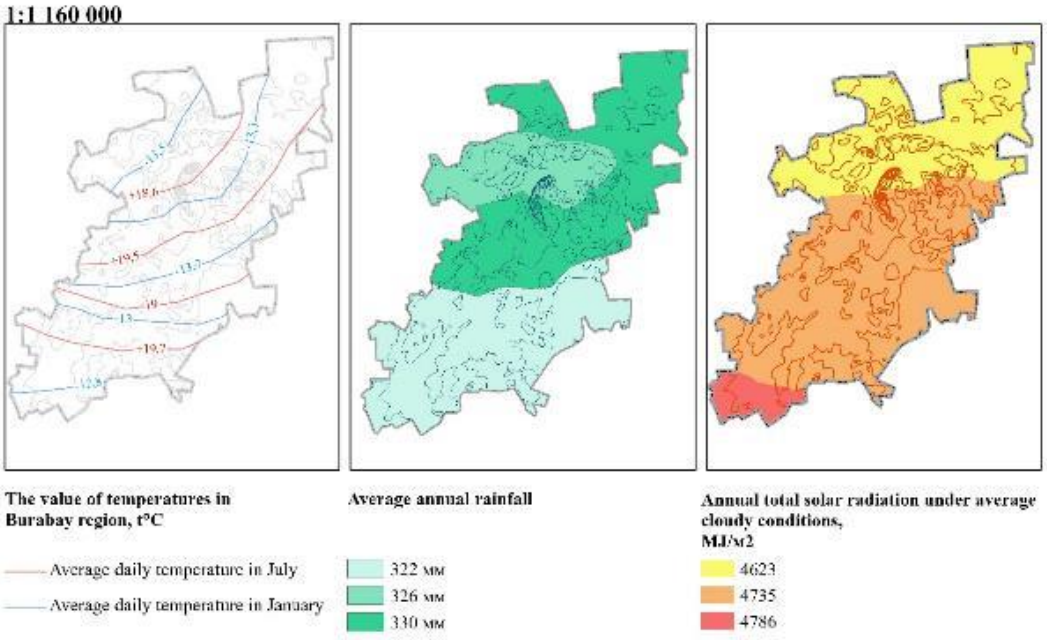

Figure 2. Climatic features of Burabay region (compiled by the author from the source [6])

Hydrographic is on the territory of the region is developed unevenly (Figure 3). Most of the water bodies (lakes, rivers), as well as numerous dry valleys, such as gullies, which are filled with water only in the spring, originate in the Kokchetav Upland and the Kazakh Upland and are concentrated in the northern part of the region. The most significant rivers are Kenashy, Arshaly, Kalshaakty, Zholboldy.

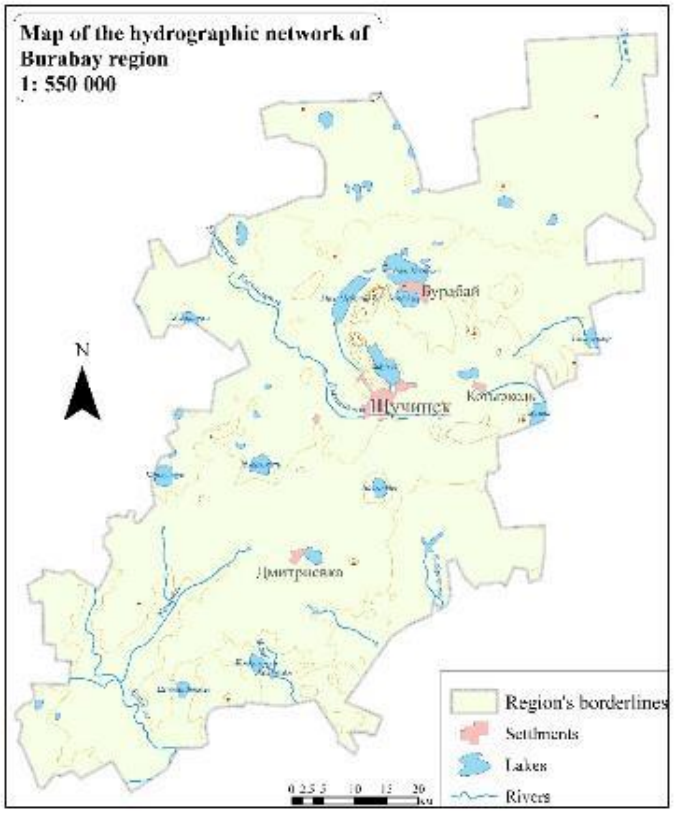

Figure 3. The hydrographic network of the Burabay region

Analysis and discussion

Landscapes are separated by natural boundaries. They are transitional bands of different widths and have different origins. There is no "leading" factor in their formation. Since the differentiation of landscapes is determined by zonal and azonal factors, they also determine the boundaries of landscapes [7].

A landscape is one of the types of geosystems (completely natural, natural-anthropogenic- or anthropogenic geosystem), characterized by the homogeneity of combinations and interrelationships of the components that make up the landscape, the homogeneity of the exchange of matter and energy between the components, and functional integrity [8, p. 23].

About geosystems, geographic components serve as structural parts of their vertical (radial, tiered) structure, since they are characterized by an ordered, tiered arrangement within the geosystem.

To create a relief map, we used SRTM (Shuttle Radar Topographic Mission) satellite imagery, a radar topographic survey covering most of the globe, except the northernmost and oceans [9].

The SRTM imagery data were obtained from references [10], respectively.

Using the SRTM satellite image, the relief was washed along the cut-out border (along the border of the Burabay region) in the ArcGIS 10.1 program (Figure 4).

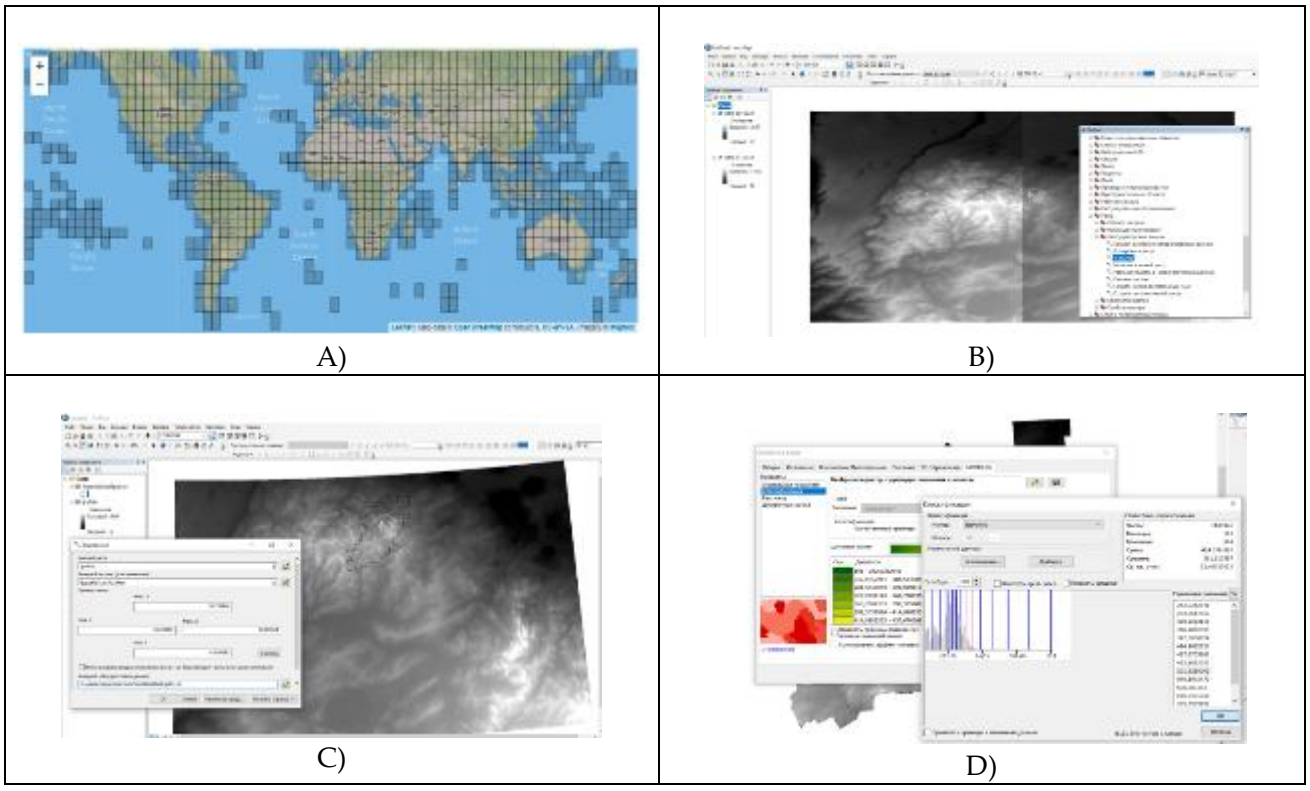

Figure 4. Shading the relief of the study area;
a) downloading, b) application of tools, c) image classification, d) plotting relief contours

The calculation of the main morphometric parameters of the relief from radar images allows dividing the earth's surface into areal elements or contours within which the analysis of spatial relationships with the characteristics of the soil and vegetation cover is carried out. The next step is to merge the channels of the SRTM images (Figure 4-b). After changing the coordinate system to the required one, we use the shading of the cut-out area relief (along the border of the Burabay region). Shading - a grayscale model of the surface with the relative position of the sun taken into account when

shading the image. This function uses latitude and azimuth properties to set the position of the light source (Figure 4-c). A standard gray color scheme is used to display the elevation model. After shading (Figure 4-d), we obtain a height map, which, after classification into 14 divisions, adjusted manually and decorated, we obtain a compiled relief map of the Burabay region (Figure 5).

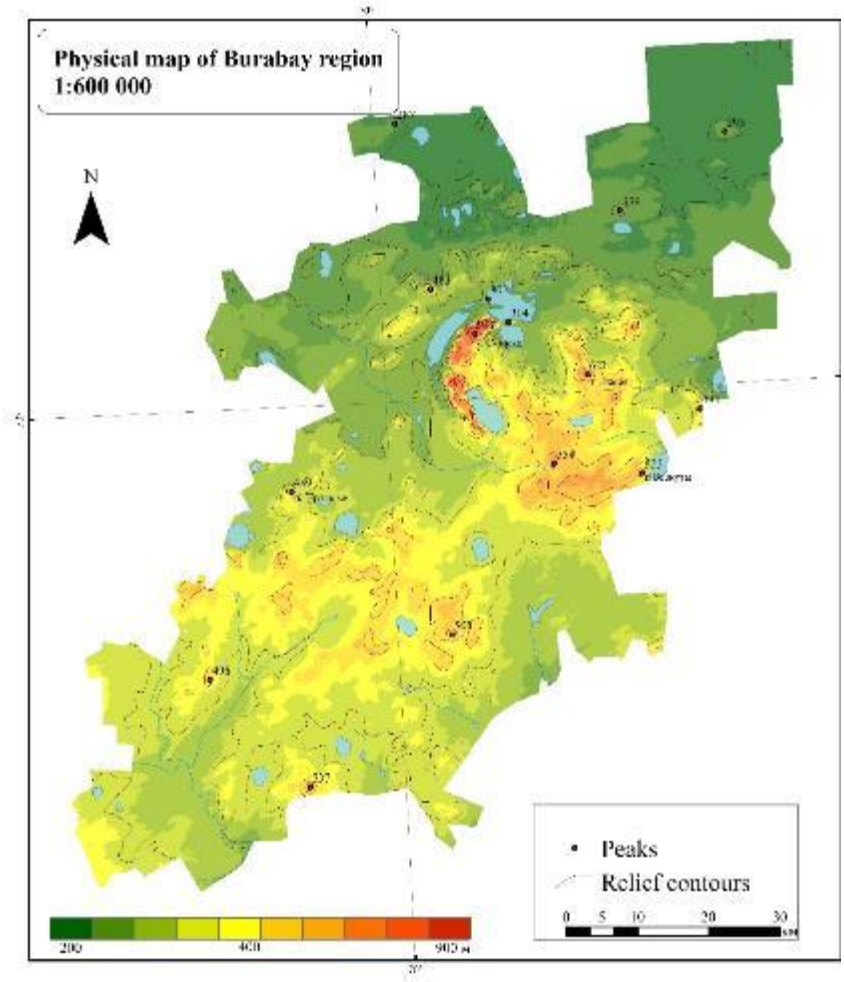

Figure 5. Relief map of Burabay region

The characteristic relief for the territory of the region is low mountains and hummocks, along with which hilly-ridged and flat areas (the southern part of the region) are widespread. Large areas of the region are covered with a mantle of loose Cenozoic deposits. The basement plains are characterized by kaolinite clays of the ancient weathering crust and Quaternary loess-like loams (western part of the region). Due to strong weathering, the most bizarre shapes have been created. The absolute heights of the plains are 200-300 m (northeastern part).

On shallow ridges, the appearance of natural complexes changes in a latitudinal direction (Kokshetau low mountains with the Sinyukha mountain range (947 m), the Airtau, Sandyktau, Maraldyn hills).

Landsat 7 multispectral imagery was used to study vegetation and soils. Landsat 7 data are derived from the Worldwide Reference System-2 (WRS-2) lane/row system, with band overlap (or lateral overlap) ranging from 7 percent at the equator to a maximum of approximately 85 percent at extreme latitudes [11].

Landsat 7 is equipped with the Enhanced Thematic Mapper Plus (ETM +) sensor, an enhanced version of the Thematic Mapper tools.

Based on the results of decoding space images of the Landsat 7 spacecraft for 2019 (Figure 6), with the additional use of stock materials and expeditionary studies by various scientists, we received a modern map of the soil and vegetation of the Burabay district of the Akmola region (Figure 7).

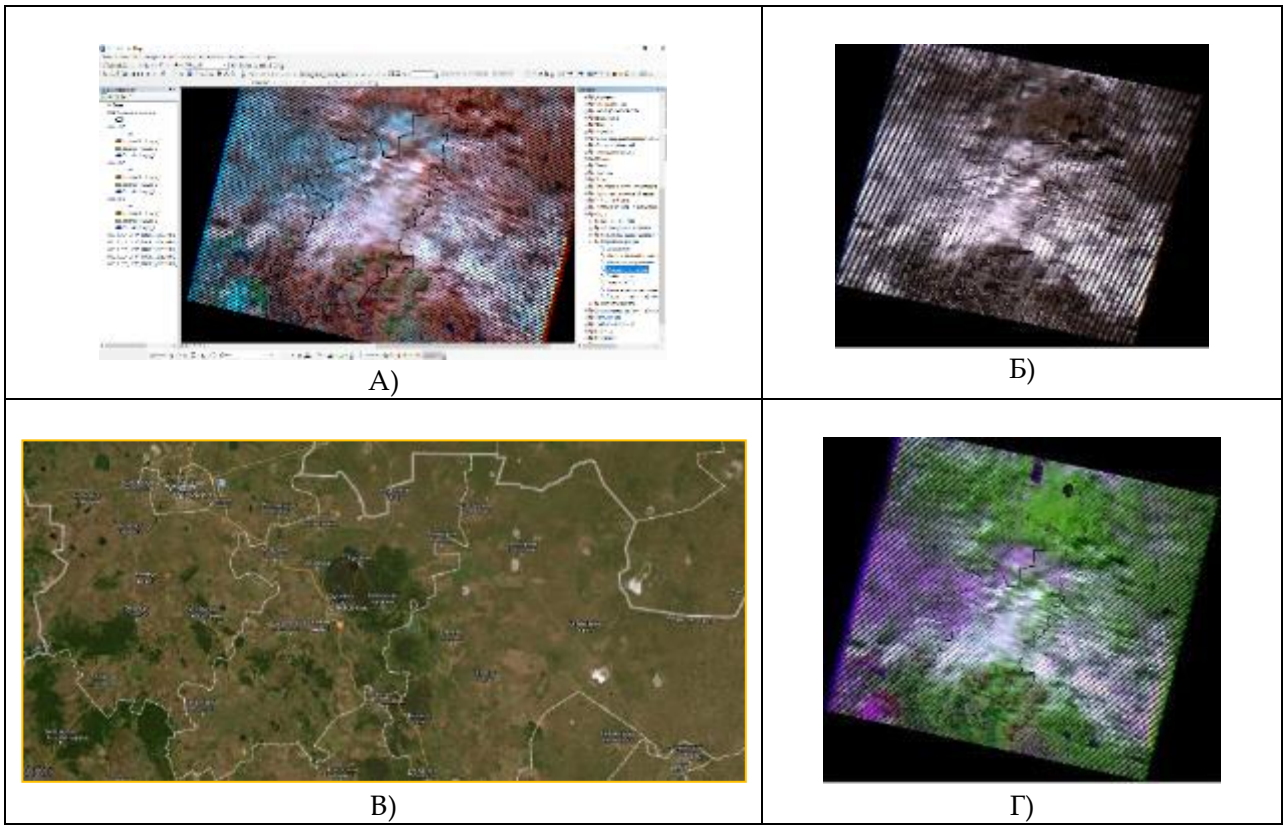

Figure 6. Decoding of satellite images of the Landsat 7 spacecraft;
a) downloading and processing images, b) image classification,
c) comparison of vegetation lines and soil lines with the decoded image, d) classification of vegetation

According to the results of the study, it was revealed that a significant part of the study area is occupied by chernozems (black soils), while the soils are often salted or carbonated. Rubble chernozems with fragments of mountain-steppe solar soils prevail in the central part of the district, with forest outgrowths. In the southern part of the region, dry-steppe natural complexes are most common.

Some direct and indirect signs of soil interpretation are ambiguous: the same sign can indicate different objects and, conversely, the same object can be indicated by different signs [12, p. 82]. Therefore, when compiling a map of the soil cover of the Burabay region, we used literature data, stock materials of various state institutions (maps of the schemes of regional centers, schemes of state farms of various scales).

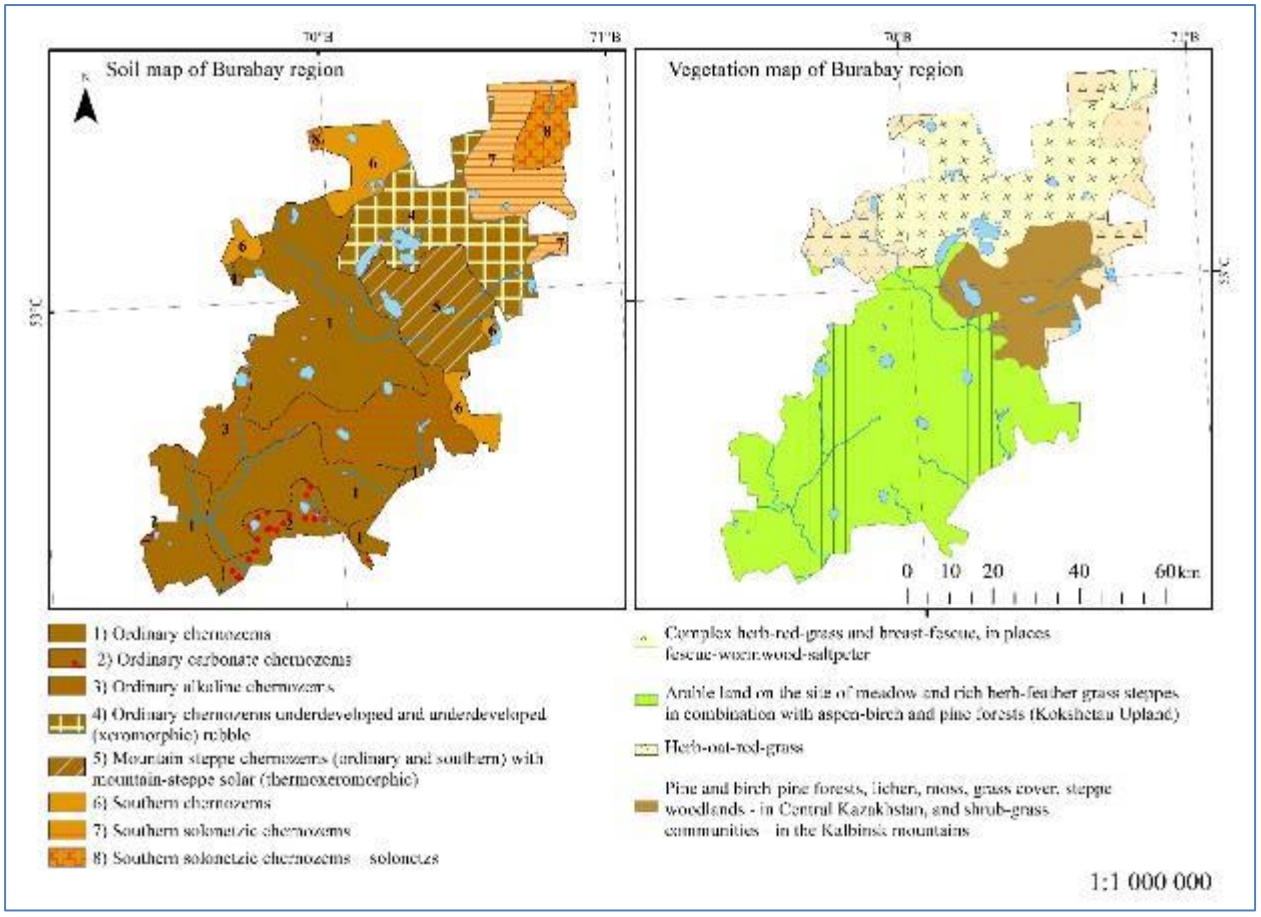

Figure 7. Maps of vegetation and soil of Burabay region

According to the results of the study of satellite images, it was revealed that most of the southern outskirts of the district are occupied by arable land and pastures (Figure 8). Forest communities prevail in the northern part (State Scientific and Production Enterprise "Burabay").

The territory of Burabay district is 594.498 hectares of which:

- Agricultural land: 358,919 hectares,

of which arable land: 204855 ha,

deposits: 11859 ha,

pastures: 140872 ha;

- Lands of settlements: 65368 hectares;
- Industrial land: 5644 hectares;
- Lands of specially protected natural areas - 90,156 hectares,

of which the land of the State Scientific and Production Enterprise "Burabay" - 89941 hectares;

- Lands of the forest fund: 40588 hectares;
- Lands of the water fund: 12683 hectares;
- Stock lands: 21140 hectares

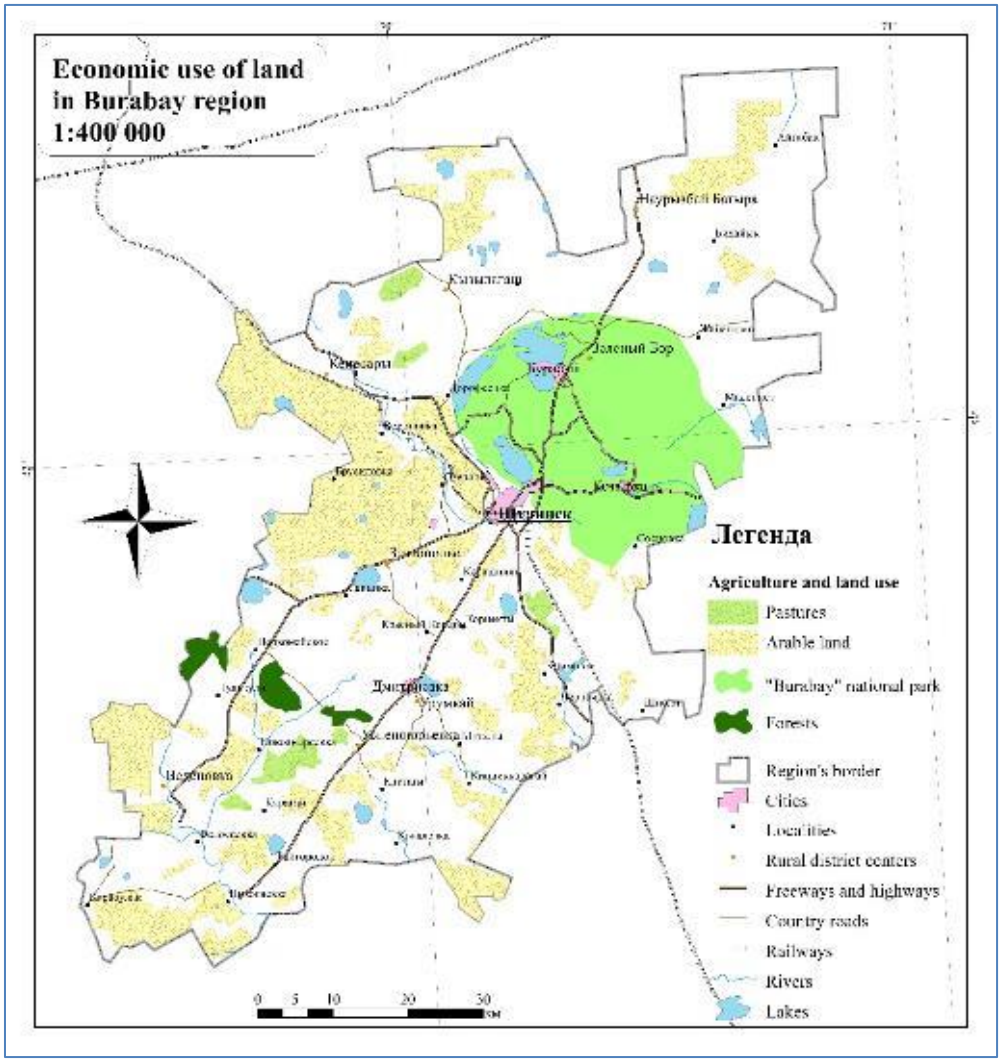

Figure 8. Map of land use in the study area

With natural landscape differentiation, the territory is considered as a spatial reality that has certain regional features that manifest themselves in ecologically significant properties of landscapes. That is, those that may or may not contribute to the manifestation of environmental problems (for example, a weak reservoir, light soil texture, anticyclonic type of weather, etc.), as well as those that are of value (habitat of commercial fauna, high-quality forests, aesthetically valuable properties of landscapes, etc.), the loss of which leads to significant damage. The selection of these properties (criteria) is one of the key points during the study since it is necessary to determine a kind of reference point when establishing the level of changes in properties that indicate the occurrence of an environmental problem [13, p. 76].

After analyzing maps of nature, literary sources, deciphering images, we proceeded to the direct creation of a landscape map. The basis for the creation was a topographic map of the Burabay region at a scale of 1: 250,000, on which the main types of natural boundaries can be distinguished as watershed-upland, ravine-hollow, valley-floodplain, swamp, the main territories of the most changed landscapes - arable lands [14, p. 260]. The Landsat 7TM apparatus [11] for 2019 was also used to interpret space images using a combination of the 5th, 3rd, and 4th channels, where one can confidently distinguish between modern exodynamic processes, soil types, vegetation types, etc. both in the spectral brightness of these channels, expressed in the color of synthesized pixels and the texture formed by groups of adjacent pixels. The final stage of this stage of study was the creation of a landscape map of the Burabay

district of the Akmola region, which, because of their typological grouping, and then structural-genetic classification, are ordered into hierarchical systematics (Figure 9).

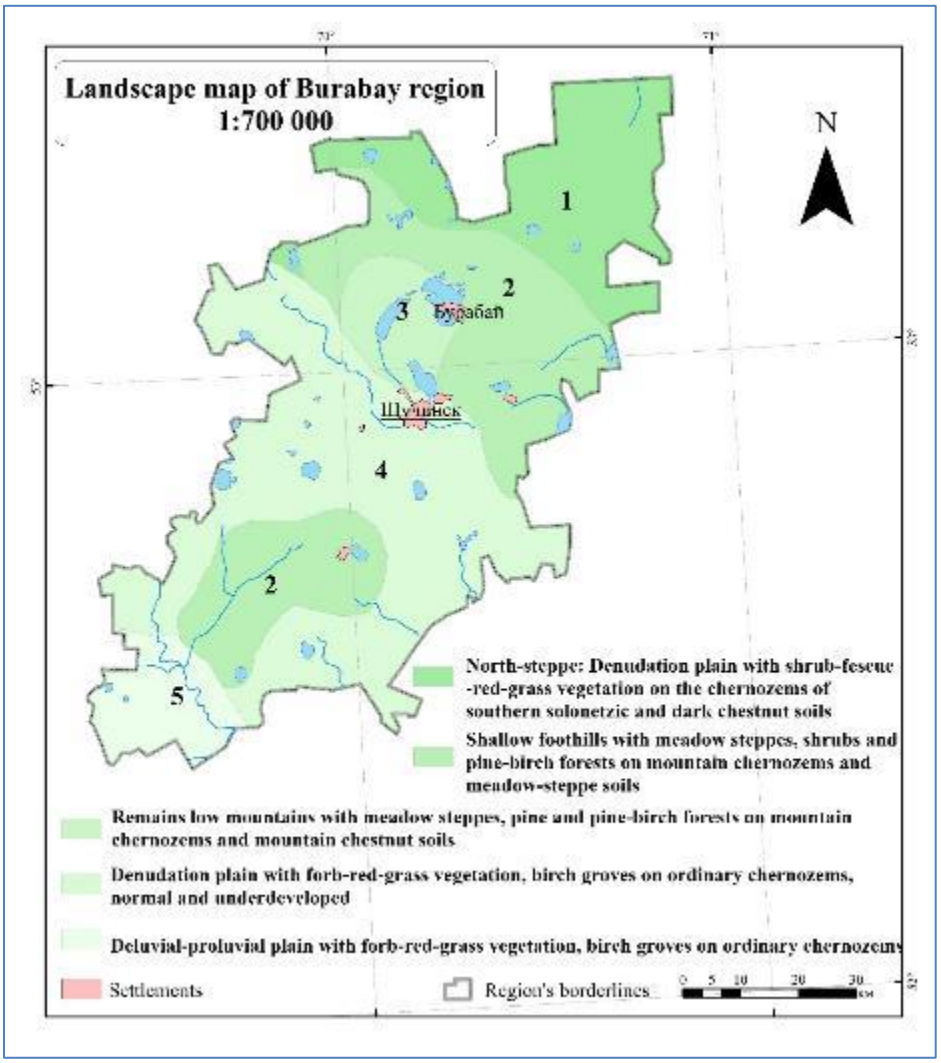

Figure 9. Landscape map of Burabay region

An analysis of landscape diversity was carried out along with the study of the natural landscape differentiation of the territory. After all, it is necessary to note that landscapes are crucial to identifying and defining environmental problems.

Landscape diversity is an organizing material and information matrix for the manifestation of preserved and lost biodiversity. Therefore, knowledge of landscape diversity serves as the basis for the analysis and generalization of scattered information about flora and fauna and as a basis for the development of a nature conservation "frame" of the territory, as well as analysis of the environment-forming functions of the landscape, various kinds of assessments of the territory, etc.

Landscape diversity should be understood as a complex of indicators reflecting landscape diversity in its various forms, diversity, contrast, uniqueness, mosaics. Knowledge of these characteristics is necessary for regional environmental management (Figure 10).

А)

Б)

Figure 10. Landscape diversity of the area; a) Kokshetau low mountains with the Sinyukha mountain range (947 m), the Airtau, Sandyktau hills,
b) Small hillside landscapes of the southern part of Burabay region - pine-birch forest-steppe near Lake Kushmurun

Species diversity, mosaicism, uniqueness, landscape dissection, the contrast of landscapes were the indicators of landscape heterogeneity. There was carried out a statistical analysis of the indicators of the diversity of the landscape structure of the Burabay region based on the analysis of the landscape map of the Akmola region.

The territory of the region is mostly occupied by pine forests formed on granite low mountains. On the Kokshetau Upland, forest landscapes develop not only in low mountains. They occupy plains and smooth hummocks, where intrusions of granitoids emerge directly to the day surface. In the southern part of the region, pine forests are replaced by birch groves on shallow hummocks. In addition, the southern part is occupied mainly by agricultural land.

Conclusion

We have compiled several thematic maps of nature that can reflect the landscape diversity of the study area using only a part of the capabilities of GIS technologies and remote sensing data in landscape analysis and the study of natural complexes.

The analysis of satellite images of medium expansion made it possible to identify the modern boundaries of residential areas, arable and pasture lands, and to create modern maps of vegetation and soil cover of Burabay district of Akmola region. Analysis of images of medium expansion made it possible to determine the hypsometric profile of the study area and its highest and lowest values.

Thus, the study of landscape features through GIS technologies can affect the definition and development of tourism activities, attracting investments in the development of infrastructure of the most attractive territories.

References

1. Гельдыева Г.В., Веселова Л.К. Ландшафты Казахстана. – Алма-Ата: Наука, 1992. – 430 с.
2. Солнцев Н.А. Природный ландшафт и некоторые его общие закономерности // Труды II Всесоюзного географического съезда. - Москва: Географгиз, 1948. – С. 258-269.
3. Капралов, Е.Г., Кошкарев, А.В., Тикунов В.С. Геоинформатика. – Москва: Академия, 2010. - 400 р.
4. Акмола: Энциклопедия. – Алматы: Атамура, 1995. - 400 с.
5. Информационно-аналитический портал. Щучинский район Акмолинской области переименован в Бурабайский район — Указ Президента РК. [Электронный ресурс] - URL: https://www.schuchinsk.kz/burabajskij-shhuchinskij-rajon (Дата обращения: 23.04.2020).

7. Метеорологические таблицы ТМ-1 за 2018-2019 гг. по станциям Акмолинской области // Акмолинская областная обсерватория. – Астана, 2018. – 125 с.

8. Исаченко Л.Г. Ландшафтоведение и физико-географическое районирование. Москва: Высш. шк,, 1991. - 366 с.

9. Мильков Ф.Н. Физическая география. Учение о ландшафтах и географическая зональность. - Воронеж: Мильков Ф.Н, 1986. - 327 с.

10. Данные SRTM, версия 1 [Электронный ресурс] - URL: http://dds. cr. usgs. gov/srtm/version1/ (Дата обращения 22.04.2020).

11. GTOPO30 and bathymetry datasets (srtm30Plus) [Электронный ресурс]. URL: http://topex. ucsd. edu/WWW_html/srtm30_plus. Html. (Дата обращения 22.04.2020).

12. LandsatLook Viewer. [Электронный ресурс] - URL: http://landsatlook.usgs.gov (Дата обращения 22.04.2020).

13. Гельдыева Г.В., Зубакин М.Ю., Шпарфов А.А. Картографические методы исследования геоэкологического состояния Западно-Казахстанской области // Устойчивое развитие территорий: Теория ГИС и практический опыт. - Саратов - 2008 г. – 182 с.

14. Глазовская М.А. Опыт сельскохозяйственной характеристики земель на основе крупномасштабных комплексных физико-географических исследований //Вопросы географии. - 1958. - Сб. 43.

15. Саушкин Ю.Г. К изучению ландшафтов СССР, измененных в процессе производства // Вопросы географии. -1951. - Сб. 24. - С. 276-299.

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Ақмола облысы Бурабай ауданының ландшафттық ерекшеліктері

Аңдатпа. Ғылыми жұмыста дистанциялық зондылау көмегімен табиғи компоненттерді зерттеуді қоса алғанда, ландшафттық талдауда геоақпараттық технологиялардың қолданысы сипатталған. Жұмыстың басты сиқыры болып дистанциялық зондылаудың әртүрлі ақпарат көздерін қолдануға, алынған нәтижелерді тасымалдау және өңдеумен қатар, әрі қарай ландшафтарды және олардың компоненттерін талдауға пайдалануға бұрылған.

Қор және стендтік материалдарды зерделеу нәтижелері бойынша Ақмола облысы Бурабай ауданының ландшафттарына сипаттама берілді. Алынған нәтижелерді кеңістіктік міндеттерді шешу үшін және табиғи ортаның компоненттерін зерттеудегі білімді тереңдету үшін, сонымен қатар аумаққа антропогендік жүктемені зерттеуде пайдалануға болады.

Түйін сөздер: ландшафт, ландшафттық талдау, ГАЖ-технологиялар.

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Евразийский национальный университет имени Л.Н. Гумилева, Нур-Султан, Казахстан

Ландшафтные особенности Бурабайского района Акмолинской области

Аннотация. В научной работе описана применимость геоинформационных технологий в ландшафтном анализе, включая изучение природных компонентов посредством дистанционного зондирования. Главный фокус работы смещен на применение различных источников информации дистанционного зондирования, перенос и обработку полученных сведений с дальнейшим их использованием при анализе ландшафтов и их компонентов. По результатам изучения стендовых и фондовых материалов дана характеристика ландшафтов Бурабайского района Акмолинской области. Полученные результаты могут быть использованы для решения пространственных задач и углубления знаний в сфере изучения компонентов природной

среды, а также для исследования антропогенной нагрузки территории.

Ключевые слова: ландшафт, ландшафтный анализ, ГИС-технологии.

References

1. Geldyeva G.V., Veselova L.K. Landshafty Kazahstana [Landscapes of Kazakhstan] (Alma-Ata: Nauka, 1992, 430 p). [in Russian]

2. Solncev N.A. Prirodnyj landshaft i nekotorye ego obshhie zakonomernosti: Trudy II Vsesojuznogo geograficheskogo siezda, Moskva: Geografgiz [Nature landscape and general patterns: Works of II Union geographic congress, Moscow: Geografgiz], 1, 258-269 (1948). [in Russian]

3. Kapralov E.G., Koshkarev, A.V., Tikunov V.S. Geoinformatika [Georgaphic informatics] (Moscow: Akademija, 2010, 400 p.). [in Russian]

4. Akmola: Enciklopedija. [Akmola: Encyclopedia] (Almaty: Atamura, 1995, 400 p). [in Russian]

5. Informacionno-analiticheskij portal. Shhuchinskij rajon Akmolinskoj oblasti pereimenovan v Burabajskij rajon — Ukaz Prezidenta RK. [Electronic resource] - Available at: https://www.schuchinsk.kz/burabajskij-shhuchinskij-rajon (Accessed 23.04.2020).

6. Meteorologicheskie tablicy TM-1 za 2018-2019 gg. po stancijam Akmolinskoj oblasti, Akmolinskaja oblastnaja observatorija [Meteorological tables TM-1 for 2018-2019 by the stations of the Akmola region, Akmola Regional Observatory], 125 (2018). [in Russian]

7. Isachenko L.G. Landshaftovedenie i fiziko-geograficheskoe rajonirovanie. [Landscape science and physical and geographical zoning] (Moscow: Vyssh. Shk, 1991. 366 p). [in Russian]

8. Milkov F.N. Fizicheskaja geografija. Uchenie o landshaftah i geograficheskaja zonalnost [Physical geography. Landscape research and geographical zoning] (Voronezh, 1986. 327 p.). [in Russian]

9. SRTM Data, version 1 [Electronic resource] – Available at: http://dds. cr. usgs. gov/srtm/version1/ (Accessed: 22.04.2020).

10. GTOPO30 and bathymetry datasets (srtm30Plus) [Electronic resource] – Available at: http://topex.ucsd.edu/WWW_html/srtm30_plus.Html (Accessed: 22.04.2020).

11. LandsatLook Viewer. [Electronic resource] – Available at: http://landsatlook.usgs.gov. (Accessed: 22.04.2020).

12. Geldyeva G.V., Zubakin M.Ju., Shparfov A.A. Kartograficheskie metody issledovanija geojekologicheskogo sostojanija Zapadno-Kazahstanskoj oblasti, Ustojchivoe razvitie territorij: Teorija GIS i prakticheskij opyt. Saratov [Cartographic research methods of geoecological state of West-Kazakhstan region, Sustainable development of territories: GIS theory and practical experience. Saratov], 182 (2008). [in Russian]

13. Glazovskaja M.A. Opyt sel'skohozjajstvennoj harakteristiki zemel' na osnove krupnomasshtabnyh kompleksnyh fiziko-geograficheskih issledovanij, Voprosy geografii [Experience of agricultural characteristics of lands based on large-scale complex physical and geographical studies, Geography questions], (43), (1958). [in Russian]

14. Saushkin Ju.G. K izucheniju landshaftov SSSR, izmenennyh v processe proizvodstva, Voprosy geografii [To the study of the landscapes of the USSR, changed in the production process, Geography questions], (24), 276-299 (1951). [in Russian]

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