

Article

Characteristics of Land Cover and Land Use in Certain Sub-Basins of the Sangzor River Basin

Kosimov Nurmukhamad¹, Sherqulova Dilafruz Rakhmatullayevna², Quvondiqov Jasur³

¹Senior Lecturer, Department of Geography, Jizzakh State Pedagogical University

^{2,3}Student of the Geography Education program at Jizzakh State Pedagogical

qosimovnurmuxamad1@gmail.com

Article information:

Manuscript received: 4 Aug 2026; **Accepted:** 28 Aug 2026; **Published:** 06 Oct 2026

Abstract: This article analyzes the land cover and land-use characteristics of the Tangatoptisoy, Jum-Jum, Baxmazorsoy, and Novqa sub-basins, located in the middle reaches of the Sangzor River basin. The study determined the total area and proportions of various land cover types within these basins, including pastures, arable land, forests and orchards, settlements, and areas devoid of vegetation. Remote sensing data—specifically the ESA WorldCover 2021 global land cover dataset—served as the methodological basis for obtaining land cover information. These data were generated with a spatial resolution of 10 meters based on imagery from the Sentinel-1 and Sentinel-2 satellites. The analysis revealed that pastures and arable land constitute the primary land-use types in the studied basins. Pastures account for 81.1% of the Tangatoptisoy basin, 67.7% of the Jum-Jum basin, 64.1% of the Baxmazorsoy basin, and 43.3% of the Novqa basin. In the Novqa basin, the share of arable land reaches 40.4%, indicating a relatively high level of agricultural development. The obtained results are of significant scientific and practical importance for assessing natural resource utilization in the Sangzor basin based on the basin principle and for identifying the spatial characteristics of land use.

Keywords: Sangzor River, sub-basin, land cover, land use, pasture, arable land, remote sensing, Sentinel-1, Sentinel-2, ESA WorldCover, basin approach

1. Introduction

Studying land cover and its utilization characteristics is a key aspect of physical-geographic research. Land cover reflects the interplay between the natural and anthropogenic components of a territory, enabling the identification of spatial patterns in natural resource use. This relationship—specifically how land-use forms depend on elevation, topography, climate, and water resources—is particularly evident when analyzed at the scale of small river basins[1].

Remote sensing and geographic information technologies are currently widely employed to identify and monitor land cover. Satellite imagery allows for the rapid identification of land cover types, the calculation of their surface areas, and the assessment of changes over time. One globally utilized dataset is ESA WorldCover; its 2021 product was generated with a spatial resolution of 10 meters using data from the Sentinel-1 and Sentinel-2 satellites. These data facilitate the spatial differentiation of forests, shrublands, grasslands, croplands, settlements, barren land, and water bodies[2-3].

The Sangzor River basin is situated in the mountainous and piedmont regions of Uzbekistan, where patterns of natural resource utilization are closely linked to the area's natural conditions. Land use characteristics vary across the basins of the river's smaller tributaries and streams. Factors such as elevation changes, slope steepness, the distribution

of soil and vegetation cover, and the spatial patterns of human settlement play a significant role in this regard.

The objective of this study is to determine the spatial distribution of land cover and land use types within the Tangatoptisoy, Jum-Jum, Baxmazorsoy, and Novqa basins—located along the middle reaches of the Sangzor River—and to conduct a comparative analysis of their key characteristics[4].

Research methods. The study employed a basin-based approach alongside comparative-geographic, cartographic, statistical, and remote sensing methods. The small basins adjacent to the middle reaches of the Sangzor River—specifically Tangatoptisoy, Jum-Jum, Baxmazorsoy, and Novqa—were selected as the study objects.

The ESA WorldCover 2021 global land cover dataset served as the methodological basis for acquiring land cover and land use data. The ESA WorldCover 2021 product was generated using data from Sentinel-1 and Sentinel-2 satellites and has a spatial resolution of 10 m. Using this data, the primary land cover types within the small basins under study were identified[5].

2. Materials and Methods

The study employed a basin-based approach, comparative-geographical, cartographic, statistical, and remote sensing methods to analyze land cover and land-use characteristics in the Tangatoptisoy, Jom-Jom, Baxmazorsoy, and Novqa sub-basins of the Sangzor River basin. The ESA WorldCover 2021 dataset with a spatial resolution of 10 m, derived from Sentinel-1 and Sentinel-2 satellite data, was used as the primary data source. Digital elevation models and hydrographic data were applied to delineate the boundaries of the studied sub-basins. GIS-based analysis was used to identify land-cover classes and calculate their areas. The proportion of each land-cover type was determined as the ratio of its area to the total basin area. Finally, statistical and comparative analysis was used to identify differences in land-use structure among the four sub-basins and to assess the influence of relief, elevation, vegetation, water resources, and settlement patterns on their spatial distribution.

3. Results

Digital elevation models and hydrographic data were used to delineate the boundaries of the small basins. The areas of the land cover classes were calculated within a GIS environment. For each land cover type, its proportion of the total basin area was determined using the following formula:

$$U = (M_i / M_h) \times 100$$

where:

U – the proportion of a specific land cover type within the basin, %;

M_i – the area of the specific land cover type, km²;

M_h – the total area of the basin, km².

The obtained results were subjected to statistical and comparative analysis, and the differences between the small basins were identified.

Main Section. Tangatoptisoy is one of the major streams flowing into the middle reaches of the Sangzor River from the left, within the territory of Sutlibuloq village. The total area of the basin is 64 km². One of Tangatoptisoy's major tributaries is Tagobsoy; it originates at an elevation of 2,800 meters above sea level and is fed by snowmelt and rainwater[6].

The basin area contains lands utilized for agriculture, livestock farming, and recreational purposes. The region's natural conditions and altitudinal zonation have resulted in significant variations in land cover. The average annual precipitation in the basin is approximately 430 mm, increasing from the lower reaches toward the foothills and

the high-altitude watershed areas. The soil cover consists primarily of light sierozem, dark sierozem, and brown soils[7].

Pastures occupy the largest portion of the Tangatoptisoy basin. Covering an area of 51.9 km², they account for 81.1% of the basin's total area. This indicates the high regional importance of livestock farming. Arable land constitutes 5.2 km² (8.1%), while forests and orchards cover 4.6 km² (7.1%)[8].

Settlements cover an area of 1.2 km², accounting for 1.8% of the total territory. Areas devoid of vegetation make up 1.1 km², or 1.7%. The share of water bodies and other land types is very small.

The Jom-Jom stream is a left tributary of the Sangzor River; it has a total length of 18 km and a basin area of 45 km². The stream originates on the northern slope of Mount Chumqor at an elevation of approximately 2,900 m and descends to an elevation of 1,100 m.

Settlements such as Jom-Jom and Sovuqbuloq are located within the basin. Pastures and arable lands play a primary role in the area's land use. Pastures cover 30.5 km², constituting 67.7% of the basin. Arable land covers 9.5 km², representing a 21.5% share[9].

Forests and orchards account for 2.9 km², or 5.7%. Areas without vegetation cover 1.06 km², while settlements occupy 0.6 km².

Altitudinal zonation is a key factor influencing land use in the Jom-Jom basin. Pasture use is widespread in the area extending from the foothill zone to the ridgeline of Mount Chumqor. In the lower and middle reaches of the basin, forms of rain-fed agriculture are practiced. The conversion of some rain-fed lands into orchards—utilizing groundwater—indicates a shifting pattern of land use[10].

Baxmazorsoy is a major stream originating in the Chumqor Mountains; it spans 23 km in length and has a basin area exceeding 54 km². The basin widens and rises in elevation from north to south—that is, towards the stream's headwaters. Five relatively large tributaries feed into the stream.

The basin contains the village of Mo'g'ol, part of the village of Uyas, and other settlements. These settlements are primarily located on the right bank of the stream.

Pastures constitute the dominant land cover type in the Baxmazorsoy basin. Covering an area of 34.3 km², pastures account for 64.1% of the basin's total area. Forests and orchards occupy 10.2 km² (18.7%), while arable land covers 5.7 km² (10.2%)[11].

Areas devoid of vegetation cover make up 3.3 km² (6%), and settlements along with other land types account for 0.6%.

The presence of areas covered by dense, low-growing vegetation within the Baxmazorsoy basin is also particularly significant. Such areas are found on mountain slopes and along the fringes of arable land, illustrating the spatial connection between natural vegetation and agricultural land[12].

The Novqa basin formed within the catchment area of the stream of the same name. The Novqa stream is 24 km long, and its basin covers a total area of 92 km². The basin slopes downward and narrows from southeast to northwest.

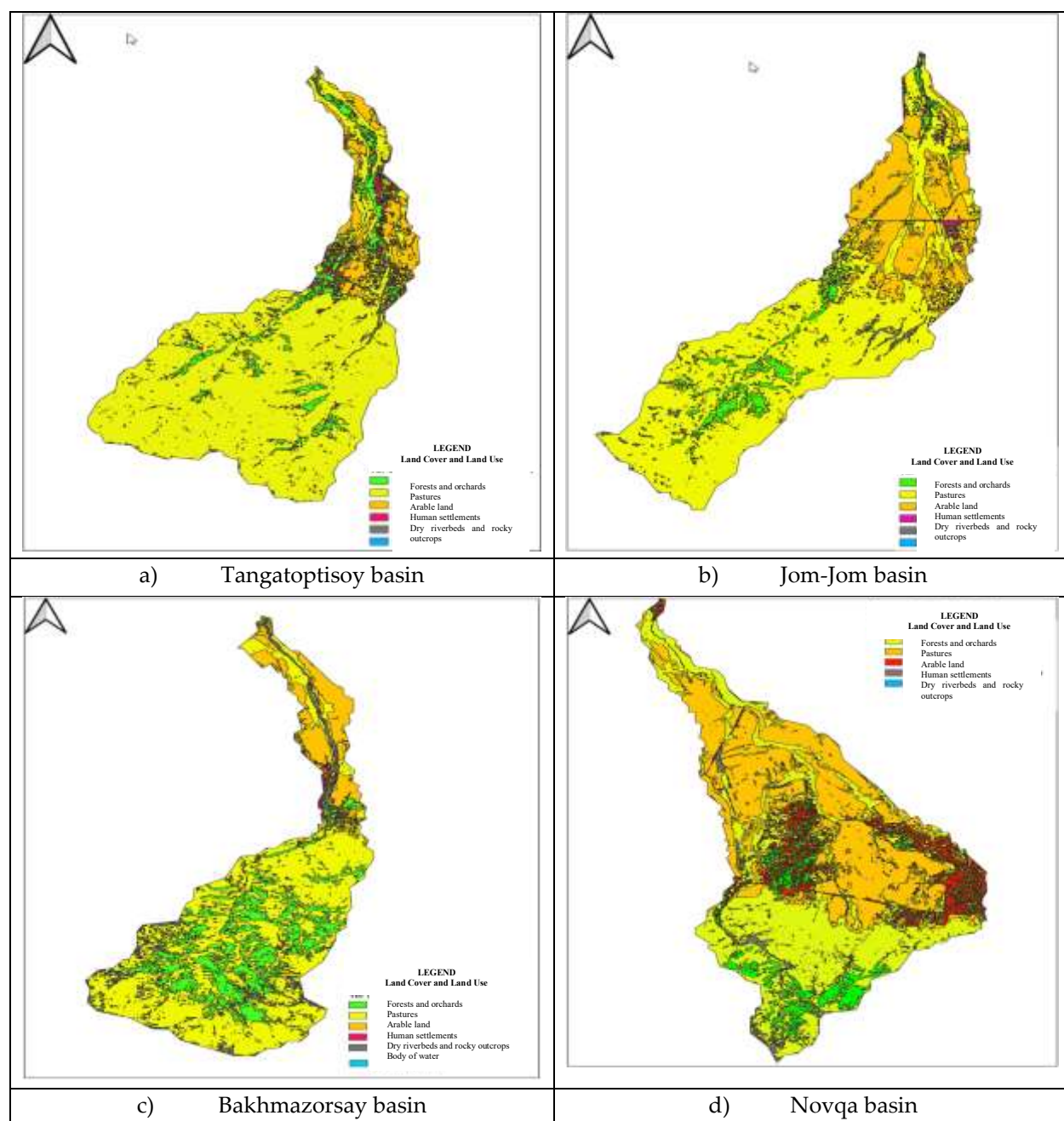


Figure 1. Land cover and land use characteristics of the Sangzor River sub-basins:

The population is concentrated primarily in the middle and lower sections of the basin. Villages such as Novqa, Pastki Novqa, Oqtosh, and Saroy constitute the main settlements in the area.

Pasture and arable land dominate the land-use structure of the Novqa basin. Pastures account for 39.9 km² (43.3%), while arable land covers 37.2 km² (40.4%). Compared to other studied basins, this figure indicates a high proportion of arable land.

Forests and orchards cover 6.3 km² (6.8%), settlements occupy 5.7 km² (6.1%), and land devoid of vegetation accounts for 2.9 km² (3.1%). Thus, the Novqa basin features a high overall share of agricultural land, with crop farming serving as a key component of the basin's economy[13-14].

A comparison of data from the four studied sub-basins reveals significant differences in their land-use structures (Table 1).

Table 1. Comparative analysis of land cover indicators for small basins

Basin	Area, km ²	Pasture, %	Arable land, %	Forests and orchards, %	Human settlements, %
Tangatoptisoy	64	81,1	8,1	7,1	1,8
Jom-jom	45	67,7	21,5	5,7	1,3
Baxmazorsoy	54+	64,1	10,2	18,7	0,6
Novqa	92	43,3	40,4	6,8	6,1

As shown in the table, the Tangatoptisoy basin accounts for the highest proportion of pastureland—81.1%. Pastures also constitute the primary form of land use in the Jom-Jom and Baxmazorsoy basins. In the Novqa basin, however, arable land accounts for a significant share alongside pastures[15-16].

The Novqa basin stands out regarding the proportion of arable land, which constitutes 40.4% of the area. In contrast, the share of arable land is 21.5% in the Jom-Jom basin, 10.2% in the Baxmazorsoy basin, and 8.1% in the Tangatoptisoy basin.

The Baxmazorsoy basin has the highest proportion of forests and orchards—18.7%. This is attributed to the basin's mountainous natural conditions and altitudinal zonation. The share of human settlements is relatively high in the Novqa basin, accounting for 6.1%[17].

Overall, the spatial composition of land cover and land use in the studied basins is influenced by factors such as relief, elevation, natural vegetation, soil, water resources, and population distribution. While pasture use predominates in mountainous and high-altitude areas, arable land, orchards, and human settlements are more prevalent in the lower and middle reaches[18].

4. Conclusion

An analysis of land cover and land-use characteristics in the Tangatoptisoy, Jum-Jum, Baxmazorsoy, and Novqa sub-basins—located along the middle reaches of the Sangzor River—has led to the following conclusions.

First, pastures and arable lands constitute the primary components of land use across all the studied basins. This indicates the significant regional importance of livestock farming and crop cultivation in this part of the Sangzor basin.

Second, pastures account for the highest proportion in the Tangatoptisoy basin, at 81.1%. Pastures make up 67.7% in the Jum-Jum basin, 64.1% in the Baxmazorsoy basin, and 43.3% in the Novqa basin.

Third, the highest share of arable land is observed in the Novqa basin, amounting to 40.4%. This indicates that agricultural activity—specifically crop cultivation—occupies a larger area in this basin compared to the other sub-basins studied.

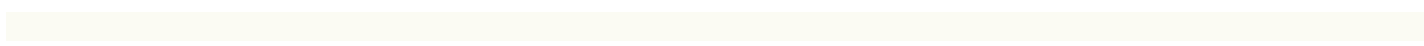
Fourth, the share of forests and orchards reaches 18.7% in the Baxmazorsoy basin. This figure is attributed to the relatively well-preserved natural vegetation cover in the mountainous part of the basin and the utilization of orchards.

Fifth, the spatial composition of land cover and land use is directly linked to the natural conditions and altitudinal zonation of the basins. While pastures and natural vegetation predominate in high-mountain areas, cultivated lands, orchards, and human settlements are more widespread in the lower and middle reaches.

The obtained results can be utilized to improve natural resource utilization, ensure the rational use of land resources, and implement spatial planning at the level of sub-basins within the Sangzor River basin. In the future, it would be advisable to determine the dynamic changes in agricultural lands, pastures, forests, and human settlements by comparing land cover data across different years.

REFERENCES

- [1] ESA WorldCover, "ESA WorldCover 2021: Global Land Cover Map at 10 m Resolution," European Space Agency, 2021.
- [2] D. Zanaga, R. Van De Kerchove, D. Daems, W. De Keersmaecker, C. Brockmann, G. Kirches, J. Wevers, O. Cartus, M. Santoro, S. Fritz, M. Herold, N. E. Tsendbazar, P. Hu, F. Ramoino, and O. Arino, "ESA WorldCover 10 m 2021 v200," Zenodo, 2022.
- [3] M. Drusch, U. Del Bello, S. Carlier, O. Colin, V. Fernandez, F. Gascon, B. Hoersch, C. Isola, P. Laberinti, P. Martimort, A. Meygret, F. Spoto, O. Sy, F. Marchese, and P. Bargellini, "Sentinel-2: ESA's optical high-resolution mission for GMES operational services," *Remote Sensing of Environment*, vol. 120, pp. 25–36, 2012.
- [4] R. Torres, P. Snoeij, D. Geudtner, D. Bibby, M. Davidson, E. Attema, P. Potin, B. Rommen, N. Floury, M. Brown, I. N. Traver, P. Deghaye, B. Duesmann, B. Rosich, N. Miranda, C. Bruno, M. L'Abbate, R. Croci, A. Pietropaolo, M. Huchler, and F. Rostan, "GMES Sentinel-1 mission," *Remote Sensing of Environment*, vol. 120, pp. 9–24, 2012.
- [5] R. G. Congalton and K. Green, *Assessing the Accuracy of Remotely Sensed Data: Principles and Practices*, 3rd ed. CRC Press, 2019.
- [6] National Atlas of the Republic of Uzbekistan, cartographic materials on natural resources and natural-geographical conditions.
- [7] N. D. Kasimov, *Applying a Basin-Based Approach to Improving the Utilization of the Sangzor Valley's Natural Resources*, dissertation for the degree of Doctor of Philosophy (PhD) in Geographical Sciences, Jizzakh, Uzbekistan, 2026.
- [8] Research Materials on the Natural Conditions, Land Cover, and Land Use of the Sangzor River Basin.
- [9] N. D. Qosimov, "Sangzor daryo havzasi hududida joylashgan ma'muriy birliklarni GAT texnologiyalari asosida aniqlash" [Identification of administrative units located within the Sangzor River basin using GIS technologies], conference paper, Zenodo, Jun. 2025. doi: 10.5281/zenodo.15633250. [Online]. Available: <https://zenodo.org/records/15633250>
- [10] J. Xolmirzaev and N. Qosimov, "Sangzor daryosi landshaftlarining ekologik holati" [The ecological state of the landscapes of the Sangzor River], *Interpretation and Researches*, Zenodo, Jan. 2024. doi: 10.5281/zenodo.10601927. [Online]. Available: <https://zenodo.org/records/10601927>
- [11] A. M. Shovqiyev, S. Sh. Raximov, and M. B. Abdug'aniyeva, "Masofadan zondlash ma'lumotlaridan foydalanib mavzuli xaritalar yaratish" [Creating thematic maps using remote sensing data], in *Shimoliy mintaqalarda qishloq xo'jaligini rivojlantirishning dolzarb masalalari va ularning innovatsion echimlari (conf. proc.)*, Republic of Karakalpakstan: Ilm-fan va innovatsiyalar akademiyasi, 2026. doi: 10.5281/zenodo.19240076. [Online]. Available: <https://zenodo.org/records/19240076>
- [12] M. Turobboyev and D. Sattarov, "Masofadan zondlash ma'lumotlari va GAT texnologiyalari asosida lalmi yer maydonlarini monitoring qilish usulini ishlab chiqish (Parkent tumani misolida)" [Developing a method for monitoring rain-fed lands based on remote sensing data and GIS technologies (the case of Parkent district)], Zenodo, May 2026. doi: 10.5281/zenodo.20030122. [Online]. Available: <https://zenodo.org/records/20030122>
- [13] A. G'afforov, "Sherobod tumanida mavjud yer fondi ma'lumotlari tahlili" [Analysis of land fund data in Sherobod district], *AGROINNOVATSIYA*, vol. 4, no. 3, pp. 108–111, 2026, ISSN 3030-3249. doi: 10.5281/zenodo.20844011. [Online]. Available: <https://zenodo.org/records/20844011>
- [14] D. Zanaga et al., "ESA WorldCover 10 m 2020 v100," Zenodo, 2021. doi: 10.5281/zenodo.5571936. [Online]. Available: <https://zenodo.org/records/5571936>
- [15] P. Lemenkova, "Land cover analysis in the Yangtze River Basin for detection of wetland agriculture and urban dynamics in Wuhan area (China)," *Transylvanian Review of Systematical and Ecological Research*, vol. 27, no. 1, pp. 1–16, 2025. doi: 10.5281/zenodo.14924808. [Online]. Available: <https://zenodo.org/records/14924808>

-
- [16] Y. A. Mane, S. S. Mane, and K. I. Mulani, "Change detection in land use and land cover using remote sensing data and GIS," *Int. J. Humanities, Social Science, Business Management & Commerce*, vol. 8, no. 3, pp. 262–268, 2025. doi: 10.5281/zenodo.14598237. [Online]. Available: <https://zenodo.org/records/14598237>
- [17] M. Patil, A. Bhagat, S. Wandre, and M. Patil, "Integrating remote sensing and GIS for LULC studies in the Warana River Basin," *Int. J. Sci. Res. Technol.*, vol. 3, no. 3, pp. 359–365, 2026, ISSN 2394-7063. doi: 10.5281/zenodo.19356784. [Online]. Available: <https://zenodo.org/records/19356784>
- [18] A. T. Adeyokunnu, "Determination of land use, drainage, and elevation map of Lower River Ogun, South-Western, Nigeria, using GIS and remote sensing," *Nigerian Research J. Eng. Environ. Sci.*, vol. 10, no. 2, pp. 470–474, 2025, ISSN 2635-3350. doi: 10.5281/zenodo.18061554. [Online]. Available: <https://zenodo.org/records/18061554>
- 
- A solid yellow horizontal bar spanning the width of the page at the bottom.