EPRA International Journal of Economic Growth and Environmental Issues- Peer Reviewed Journal
ISSN: 2321-6247
Volume: 14 | Issue: 6 | June 2026 | Journal DOI: 10.36713/epra0713 | SJIF Impact Factor (2026): 8.844

ANALYSIS OF VEGETATION DYNAMICS BASED ON THE SAVI INDEX IN CHIRAKCHY DISTRICT OF KASHKADARYA REGION, UZBEKISTAN

Obidjon Arabov[1], Mohira Kurambaeva[2], Maftuna Abdirakhmonova[3]
[1]Senior Lecturer, National University of Uzbekistan, Uzbekistan
[2]Head, Research Institute of Environmental and Nature Protection Technologies, Uzbekistan
[3]Master's student, National University of Uzbekistan, Uzbekistan

ABSTRACT--
This article analyzes the state of vegetation cover in the Chirakchi district of the Kashkadarya region and its dynamic changes between 2020 and 2025 based on the SAVI (Soil Adjusted Vegetation Index) index. The study utilized remote sensing data (Landsat 8-9 images) and GIS technologies. The use of the SAVI index made it possible to obtain high-precision results, especially in conditions of sparse vegetation, by reducing the influence of soil color. The results served to determine the spatial distribution of vegetation density, degradation and restoration processes in the region. The obtained data are of great importance for environmental monitoring, the efficient use of land resources, and agricultural planning.

KEYWORDS*: SAVI, vegetation index, remote sensing, GIS, Chirakchi District, vegetation cover, degradation, monitoring*---

1. INTRODUCTION

In recent decades, significant changes in the dynamics of vegetation cover have been observed as a result of global climate change, the intensification of anthropogenic factors, and the inappropriate and inefficient use of land resources. In particular, environmental problems such as vegetation degradation, desertification processes, and soil erosion are becoming increasingly acute in arid and semi-arid regions [1; 2]. These processes are characteristic of Central Asian regions, including the southern part of Uzbekistan the Kashkadarya region where the disruption of the natural-ecological balance is negatively impacting the fertility of land resources.

Chirakchi district, considered one of the important administrative units of the Kashkadarya region, is located in semi-desert and foothill zones due to its natural and geographical conditions, and the vegetation cover is spatially unevenly distributed. The sharp continental character of the region's climate, low precipitation, and increasing anthropogenic pressure are manifesting as the primary factors undermining the stability of the vegetation cover. Therefore, assessing the state of vegetation in such areas using traditional methods may not provide sufficient accuracy.
Currently, remote sensing technologies are widely used as an effective scientific and methodological tool that allows for the rapid, objective, and extensive assessment of the state of land cover and vegetation across vast territories [3]. Vegetation indices are the main analytical tool in this process. Among them, the SAVI (Soil Adjusted Vegetation Index) holds a special place, as it ensures high-precision results by reducing the impact of soil degradation, especially in conditions of sparse vegetation [4]. This further increases the advantage of the SAVI index in monitoring vegetation in semi-desert areas.

The primary objective of this study is to conduct a comprehensive assessment of vegetation cover dynamics based on the SAVI index in the Chirakchi district of the Kashkadarya region and to determine its spatial-temporal changes between 2020 and 2025. The research results are of great scientific and practical importance for improving the environmental monitoring system in the region, the rational use of land resources, and the scientific planning of agriculture.

Description of the study area

Chirakchi district is located in the eastern part of Kashkadarya region, and the terrain consists mainly of plains and foothill zones. The climate is sharply continental, with hot and dry summers and relatively cold winters.

EPRA International Journal of Economic Growth and Environmental Issues- Peer Reviewed Journal
ISSN: 2321-6247
Volume: 14 | Issue: 6 | June 2026 | Journal DOI: 10.36713/epra0713 | SJIF Impact Factor (2026): 8.844

In
- The amount of precipitation is low (around 300-400 mm)
- Vegetation is mainly seasonal
- Pasture and agricultural lands predominate

2. METHODOLOGY

Data source

Satellite images from Landsat 8 and Landsat 9 were used as remote sensing data in this study. This data has a spatial accuracy of 30 meters, providing sufficient accuracy for assessing the state of vegetation on a regional scale.

Within the framework of the study, images captured in August were selected, reflecting the most stable vegetation period of the summer season from 2020 to 2025. The choice of August is explained by the fact that vegetative activity of plants during this period reaches a relatively maximum level and atmospheric noise (low level of cloudiness) is low.

Calculate SAVI index

The SAVI index was calculated using the following formula:

$$\mathrm{SAVI} = \frac{(1 + \mathrm{L})(\mathrm{NIR} - \mathrm{RED})}{\mathrm{NIR} + \mathrm{RED} + \mathrm{L}}$$

here:
- NIR is the near infrared range
- RED is the red range
- L = 0.5 (for average vegetation)

Stages of GIS processing

Download satellite imagery

Images from Landsat 8/9 satellites for the study were downloaded from the USGS Earth Explorer open data platform [9]. During the selection process, preference was given to low-cloudiness and high-quality images.

Atmospheric correction

Radiometric and atmospheric corrections were performed to reduce atmospheric influences (aerosol, water vapor, and dust particles) present in the images. As a result of this stage, the actual spectral reflection values (surface reflectance) reflected from the Earth’s surface were obtained, and the accuracy of subsequent calculations was improved.

Highlight required items

Spectral ranges necessary for calculating vegetation indices were isolated. Specifically, the red range (RED - Band 4) and near-infrared range (NIR - Band 5) in Landsat images were selected as separate layers and prepared for the index calculation process.

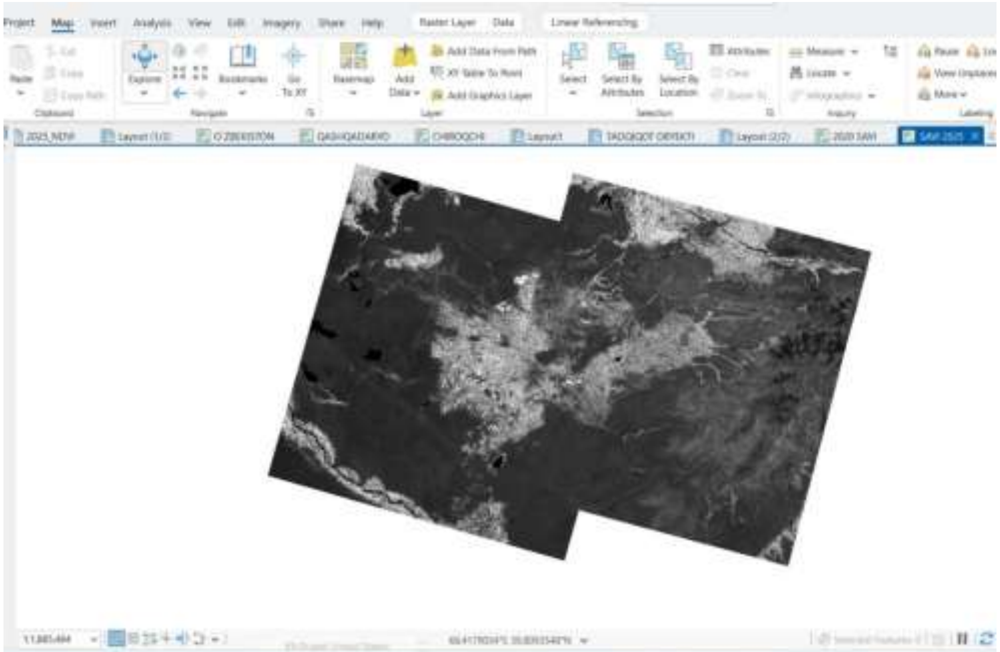

Figure 1. Perform actions on Landsat imagery.

Source: Author

Calculate SAVI using Raster Calculator

The SAVI index was calculated using the Raster Calculator module in ArcGIS Pro 3.6 software based on pre-allocated spectral bands. During the calculation process, a standard formula was applied, and the L coefficient was taken as 0.5 to reduce the impact of the soil background [5,6]. As a result, index values representing vegetation density were generated for each pixel.

Classification and coloring

The calculated SAVI values were divided into specific ranges and subjected to thematic classification. Each interval represented a certain level of vegetation density (from very low to high). To facilitate visual analysis, results are mapped based on a graded color scheme (from red to green).

Statistical analysis

Statistical indicators (average value, minimum and maximum values, standard deviation) for the region were calculated based on the obtained SAVI raster data. Additionally, the area share for each class was determined, and the dynamics of vegetation cover changes over time were analyzed. These results allowed for a deeper assessment of environmental processes in the region**.**

Classification

SAVI values were divided into the following classes:

Table 1
SAVI Index Classes

Interval	Interpretation
<0	No vegetation
0–0.2	Very low
0.2–0.4	Low
0.4–0.6	Average
>0.6	Higher

Source: Author

EPRA International Journal of Economic Growth and Environmental Issues- Peer Reviewed Journal
ISSN: 2321-6247
Volume: 14 | Issue: 6 | June 2026 | Journal DOI: 10.36713/epra0713 | SJIF Impact Factor (2026): 8.844

3. RESULTS AND DISCUSSION

The results of the analysis showed that the vegetation cover in the Chirakchi district is unevenly distributed.

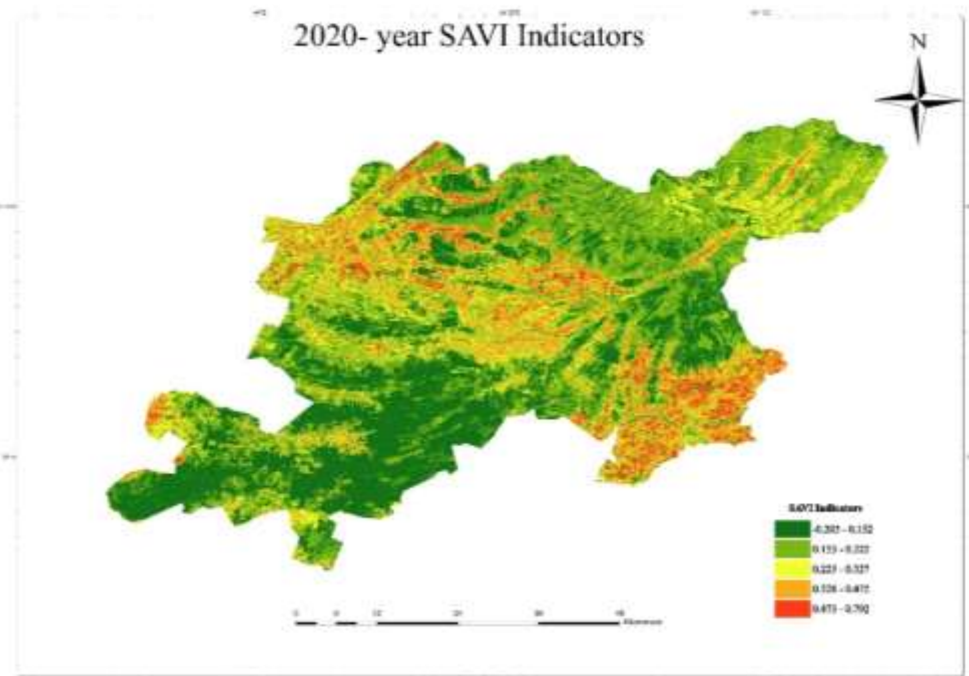

Figure 2. Map of SAVI indicators for 2020.

Source: Author

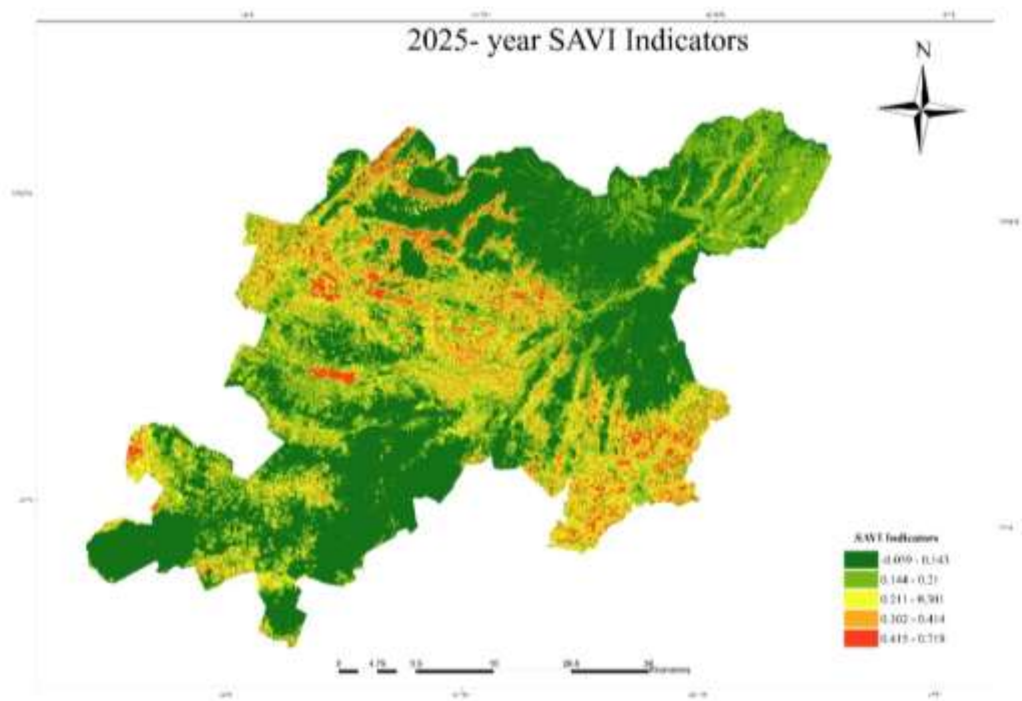

Figure 3. Map of SAVI indicators for 2025.

Source: Author

Spatial distribution of vegetation cover

Analysis of SAVI index maps for 2020 and 2025 revealed a spatially uneven distribution of vegetation cover in the Chirakchi district. Low vegetation rates are mainly observed in desert and pasture zones, which is explained by the sparse vegetation cover and the openness of the soil surface. The average vegetation level is associated with irrigated agricultural lands, where vegetation is relatively stable under anthropogenic influence.

High vegetation values were observed mainly in river valleys and foothill areas. In these zones, relatively high humidity, soil fertility, and favorable natural conditions serve as the primary factors stimulating vegetation development. Overall, SAVI maps clearly demonstrated that the vegetation cover in the region is closely linked to natural-geographical factors.

Change in vegetation cover over time (2020–2025)

Based on the research results, it was determined that certain dynamic changes were observed in the vegetation cover between 2020 and 2025. Specifically, a relative increase in SAVI values was recorded in 2021–2022, indicating an increase in vegetation activity during this period. This situation can be explained by the relatively favorable climatic conditions and the effectiveness of agrotechnical measures.

However, a decrease in vegetation indicators was observed in 2023–2024. It is assumed that this is due to the intensification of drought conditions, the depletion of water resources, and the increase in anthropogenic pressure. By 2025, a partial recovery trend in vegetation cover was noted, indicating an improvement in the state of vegetation in certain areas under the influence of natural and artificial factors.

Table 2.
Dynamics of SAVI changes for 2020–2025

SAVI class	2020 (%)	2025 (%)	Change (%)
No vegetation	12.3.	13.4.	+1.1 ↑
Very low	21.6	23.1.	+1.5 ↑
Low	27.5	26.5	−1.0 ↓
Average	23.7	22.6	−1.1 ↓
Upper	14.9	14.4.	−0.5 ↓

Source: Author

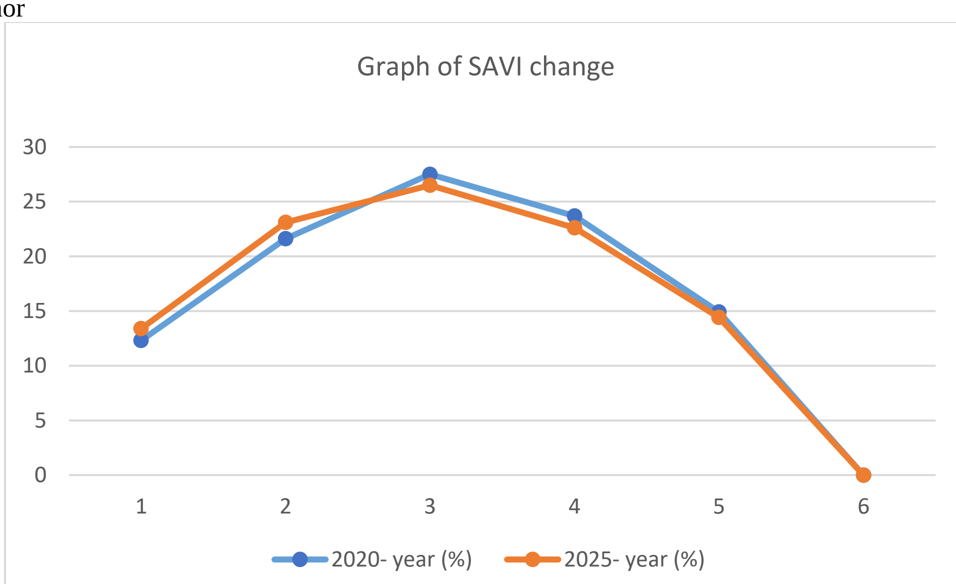

Figure 4. Graph of the SAVI index change from 2020 to 2025.

Source: Author

Factors of vegetation degradation

The analysis of the results obtained made it possible to identify the main factors influencing the change in vegetation cover in the Chirakchi district. Among them, climate change leads to a decrease in precipitation and an increase in temperature. At the same time, limited water resources lead to a reduction in the area of irrigated lands.

Furthermore, vegetation is being degraded due to the excessive use of pastures. Improper land use, including violations of agrotechnical requirements, also negatively affects the state of vegetation. The combination of these factors is leading to a disruption of the ecological balance in the region.

Efficiency and advantages of the SAVI index

The use of the SAVI index in the research process demonstrated its high efficiency. This index allows for accurate results by reducing the impact of the soil background, especially in conditions of sparse vegetation.[7] When comparing maps from 2020 and 2025, it was confirmed that even small changes in vegetation cover can be detected using SAVI.

It was also observed that the SAVI index yields more stable results than NDVI, as it reduces errors caused by exposed parts of the soil surface. This once again proves the superiority of the SAVI index for studies conducted in semi-desert regions.

4. CONCLUSION

The results of this study confirmed the high efficiency of the SAVI (Soil Adjusted Vegetation Index) index in assessing the dynamics of vegetation cover in the Chirakchi district of the Kashkadarya region. Analyses conducted based on remote sensing data obtained between 2020 and 2025 showed that the vegetation cover in the area is significantly variable in terms of space and time. Specifically, it was established that the processes of vegetation decline and partial restoration are closely linked to natural and climatic factors and anthropogenic impacts.

During the study, it was scientifically substantiated that the application of the SAVI index ensures high accuracy in determining vegetation, especially in sparse and semi-desert areas, by reducing the influence of the soil background. This aspect indicates the superiority of the SAVI index over traditional indices such as NDVI, especially in areas where open soil surfaces predominate. The results obtained once again confirm the growing importance of remote sensing technologies in vegetation monitoring under conditions of global climate change.

The results of the study also showed that the intensification of vegetation degradation processes in the region is associated with limited water resources, excessive pasture use, and improper land resource management. This implies the need to implement comprehensive monitoring systems to ensure regional environmental stability.

Overall, the results obtained based on the SAVI index serve as an important scientific and practical basis for improving environmental monitoring, the rational use of land resources, and the optimization of agricultural systems in the Chirakchi district. In the future, it is advisable to use the results of this research in territorial planning, the restoration of degraded lands, and the development of sustainable development strategies.

REFERENCES

1. *Jumanov, A., et al. (2024). Study of the dynamics of land use and land cover change using remote sensing data and GIS technologies: Case study of the Kashkadarya region. E3S Web of Conferences, 590, 04002. https://doi.org/10.1051/e3sconf/202459004002*
2. *Mamadaliev, B., et al. (2026). A machine learning-validated comparison of LAI estimation methods for urban-agricultural vegetation using multi-temporal Sentinel-2 imagery in Tashkent, Uzbekistan. Land, 15(2), 232. https://doi.org/10.3390/land15020232*
3. *Alikhanova, S., et al. (2025). Tracking vegetation dynamics in drylands with modified soil-adjusted vegetation indices. Discover Environment. https://doi.org/10.1007/s41748-025-00705-z*
4. *Rakhmatova, N., et al. (2025). Temporal and spatial dynamics of dust storms in Uzbekistan and their environmental implications. Atmosphere, 16(7), 782. https://doi.org/10.3390/atmos16070782*
5. *Mapping of agricultural drought in the past decade in Kashkadarya region using satellite remote sensing based on vegetation condition index. (2025). Remote Sensing Applications.*

6. *Otokhonov, O. D., & Ashirov, Y. R. (2025). Short-term vegetation cover change analysis (2020–2025) in the Lower Amu Darya State Biosphere Reserve using Sentinel-2 data. Ekonomika i Sotsium, 12(139), 1081–1088.*
7. *Piles, M., Chaparro, D., Entekhabi, D., Konings, A. G., Jagdhuber, T., & Camps-Valls, G. (2021). Remote sensing of vegetation dynamics in agro-ecosystems using vegetation optical depth and optical vegetation indices. Remote Sensing of Environment, 255, 112314. https://doi.org/10.1016/j.rse.2020.112314*
8. *Xue, J., & Su, B. (2022). Significant remote sensing vegetation indices: A review of developments and applications. Journal of Sensors, 2022, 1–17. https://doi.org/10.1155/2022/9362531*
9. *Thenkabail, P. S., Lyon, J. G., & Huete, A. (Eds.). (2023). Hyperspectral remote sensing of vegetation (2nd ed.). CRC Press.*