SPATIAL AND INTERANNUAL VARIABILITY OF ANNUAL PRECIPITATION IN CHARTAK DISTRICT (2000–2024)

Madinabonu Kholmurodova
Shakhnoza Mirzaeva
"Tashkent institute of irrigation and agricultural mechanization engineers" National research University, Tashkent, Uzbekistan
https://doi.org/10.5281/zenodo.23066351

Abstract. This study examines the spatial distribution and interannual variability of annual precipitation in Chartak District, Namangan Region, using precipitation maps for 2000, 2010, 2020, and 2024. Annual precipitation ranged from 225 to 260 mm in 2000 and increased to 319–348 mm in 2010. It declined to 148–183 mm in 2020 before rising to 179–254 mm in 2024. Among the four selected years, 2010 had the highest precipitation values and 2020 the lowest. The maps also show spatial differences within the district: precipitation was generally lower in the northern part, while higher values occurred in parts of the central and eastern areas. These findings highlight the need to account for both year-to-year and spatial variation when planning water and agricultural resource use. A continuous long-term trend cannot be established from the four selected years alone.

Keywords: annual precipitation; spatial distribution; interannual variability; Chartak District; Namangan Region; water resources.

Introduction

Precipitation is a key component of the local water balance and an important factor affecting agricultural production, vegetation growth, and soil conditions [1]. In areas where farming depends on both rainfall and irrigation, differences in precipitation from one year to another can change the amount of water available to crops and the need for supplemental irrigation [2]. The distribution of rainfall within a district is also important: locations receiving different amounts of precipitation may experience different soil moisture conditions even during the same year [3].

Chartak District, located in Namangan Region, provides an opportunity to examine both the temporal and spatial aspects of precipitation [4]. Maps of annual precipitation show how rainfall amounts differ across the district, while a comparison of selected years reveals changes in the overall range of recorded values [5]. Understanding these patterns can support more informed planning of agricultural activities and water resource use [6]. Precipitation information is also relevant to studies of soil erosion, although annual totals alone cannot describe the erosive effect of rainfall [7]. That assessment additionally requires information on rainfall intensity, seasonal timing, land cover, and terrain [8].

This study examines annual precipitation in Chartak District for 2000, 2010, 2020, and 2024. Its aim is to compare precipitation ranges in these four years and describe the main spatial patterns shown on the maps. The analysis focuses on selected years rather than claiming a continuous trend throughout 2000–2024. This distinction is necessary because the conditions in the years between the mapped observations cannot be established from the four maps alone.

Results

Annual precipitation maps for 2000, 2010, 2020, and 2024 were compared to examine differences between selected years and across Chartak District. The maps divide precipitation into

© 2026 Worldly Knowledge.

Mualliflik huquqi egasi tomonidan ushbu material Creative Commons Attribution 4.0 (CC BY 4.0) litsenziyasi asosida tarqatiladi.

five classes for each year. Because the class boundaries differ from one map to another, the colours must be interpreted together with their legend values when comparing years.

In 2000, annual precipitation ranged from 225 to 260 mm. The lowest values appeared mainly in the southern part of the district and in a small area at its northern end. Higher values covered much of the central and north-central area. This pattern shows that precipitation was unevenly distributed within the district (Figure 1).

By 2010, the precipitation range had increased to 319–348 mm. Both the minimum and maximum values were higher than in 2000. Relatively low values were again visible at the northern and southern ends of the district, while the highest class appeared in several central and eastern areas. Although the spatial pattern was not identical to that of 2000, both maps show clear differences between parts of the district (Figure 1).

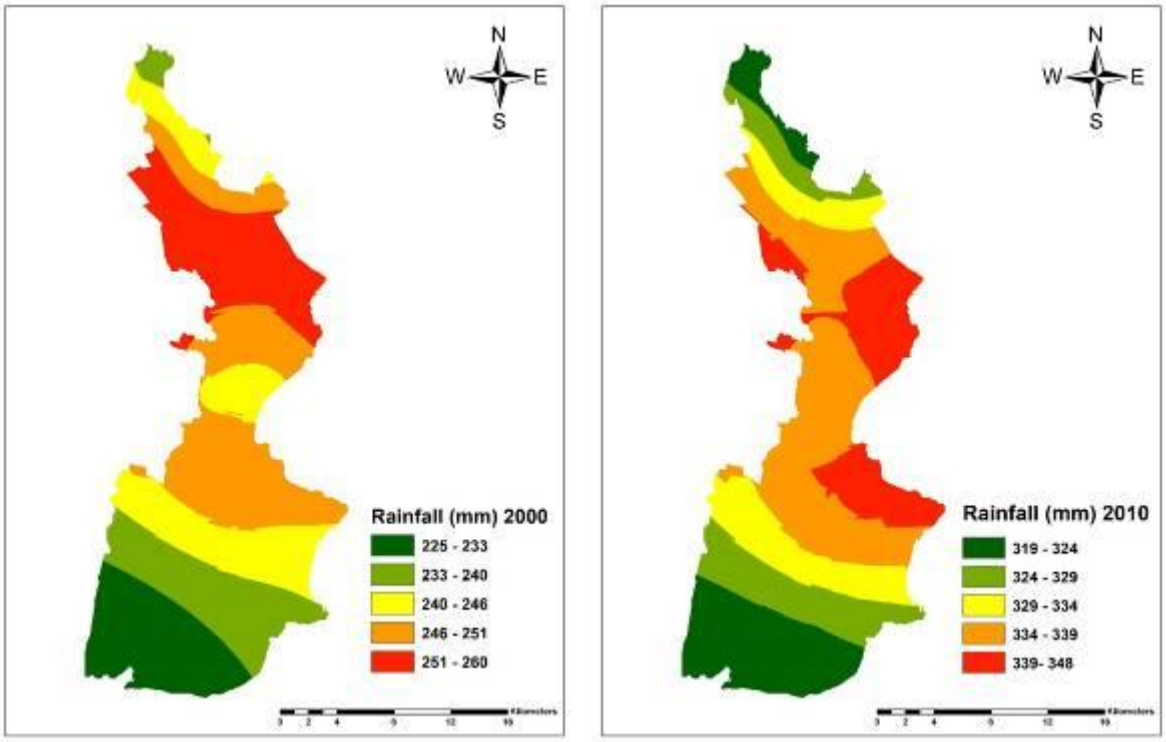

Figure 1. Spatial distribution of annual precipitation in Chartak District in 2000 and 2010.

The 2020 map shows a marked reduction in annual precipitation, with values ranging from 148 to 183 mm. This was the lowest range among the four selected years. The lowest classes were concentrated in the northern part and at the southwestern edge, whereas higher values occurred in parts of the central and eastern district (Figure 2).

In 2024, annual precipitation ranged from 179 to 254 mm. Both ends of this range were higher than in 2020, indicating a partial recovery in precipitation. The highest class remained concentrated mainly in the central-eastern part of the district, while lower values occurred in the north. The difference between the minimum and maximum values was also wider in 2024 than in the other selected years, indicating more pronounced spatial variation on the map (Figure 2).

© 2026 Worldly Knowledge.

Mualliflik huquqi egasi tomonidan ushbu material Creative Commons Attribution 4.0 (CC BY 4.0) litsenziyasi asosida tarqatiladi.

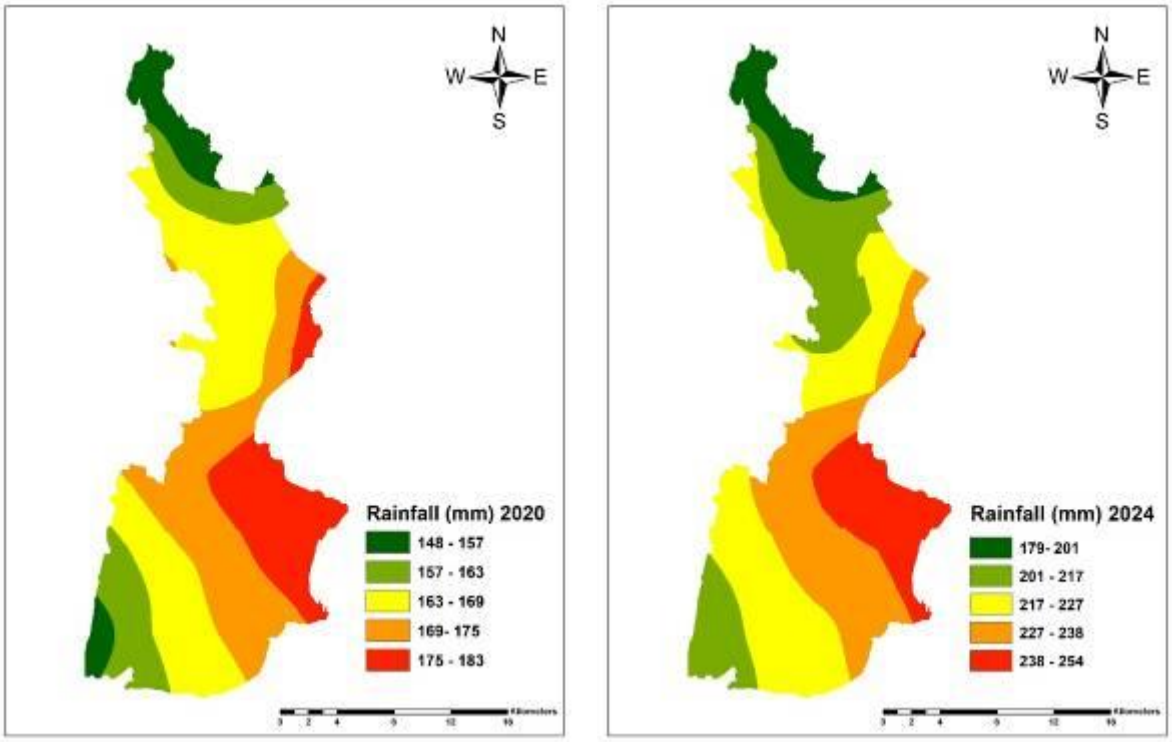

Figure 2. Spatial distribution of annual precipitation in Chartak District in 2020 and 2024.

The accompanying graph shows values of 242.5 mm for 2000, 333.5 mm for 2010, 165.5 mm for 2020, and 216.5 mm for 2024 (Figure 3). These numbers equal the midpoint between the minimum and maximum values shown on each map. They illustrate the contrast between the four precipitation ranges: the highest midpoint occurred in 2010, followed by a substantial decline in 2020 and an increase in 2024. Unless these values were calculated from all spatial observations, they should be described as range midpoints rather than district-wide mean precipitation.

Taken together, the maps show substantial differences in annual precipitation between the selected years, as well as variation within the district in each year. These results provide a basis for considering local precipitation conditions in water and agricultural planning. A statistical assessment of a long-term precipitation trend would require annual data for every year in the study period.

© 2026 Worldly Knowledge.

Mualliflik huquqi egasi tomonidan ushbu material Creative Commons Attribution 4.0 (CC BY 4.0) litsenziyasi asosida tarqatiladi.

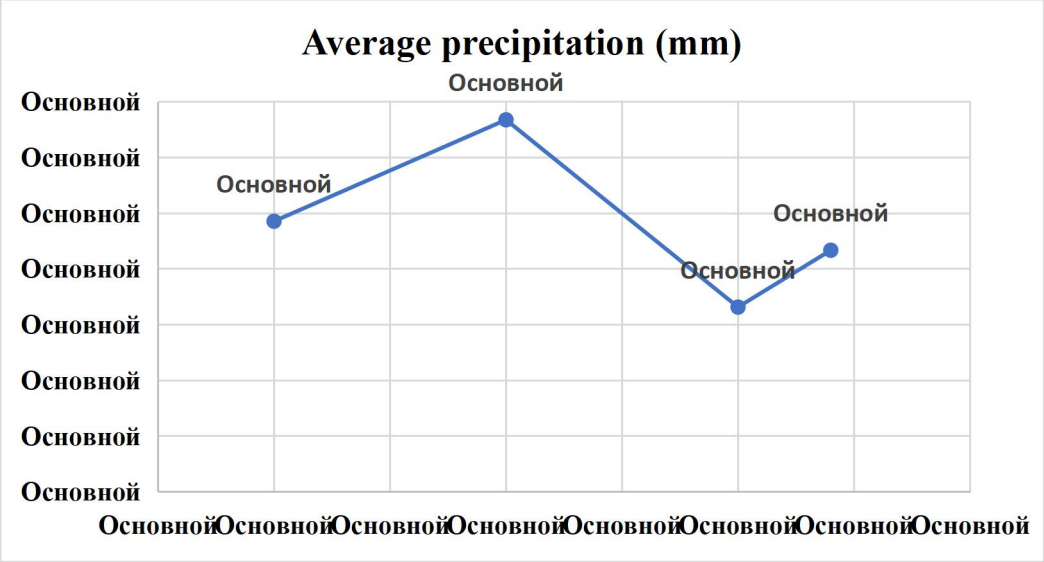

Figure 3. Midpoints of the annual precipitation ranges in Chartak District for four selected years.

Conclusions

Annual precipitation in Chartak District differed substantially across the four selected years. The highest range was recorded in 2010 (319–348 mm) and the lowest in 2020 (148–183 mm). Precipitation increased to 179–254 mm in 2024, although it remained below the 2010 range. The maps also show variation within the district: lower values generally occurred in the northern part, while higher values appeared in parts of the central and eastern areas.

These findings show why both spatial differences and changes between years should be considered in local water and agricultural planning. The four selected years illustrate precipitation variability, but they are insufficient to establish a continuous trend for 2000–2024. Further analysis using the complete annual dataset would allow that trend to be tested.

References

1. Funk, C., Peterson, P., Landsfeld, M., Pedreros, D., Verdin, J., Shukla, S., Husak, G., Rowland, J., Harrison, L., Hoell, A., & Michaelsen, J. (2015). The climate hazards infrared precipitation with stations—a new environmental record for monitoring extremes. Scientific Data, 2, 150066. https://doi.org/10.1038/sdata.2015.66 U.S. Geological Survey
2. Funk, C., Peterson, P. J., Landsfeld, M. F., Pedreros, D. H., Verdin, J. P., Rowland, J. D., Romero, B. E., Husak, G. J., Michaelsen, J. C., & Verdin, A. P. (2014). A quasi-global precipitation time series for drought monitoring (Data Series 832). U.S. Geological Survey. https://doi.org/10.3133/ds832 pubs.usgs.gov
3. Funk, C., Peterson, P., Landsfeld, M., Davenport, F., Becker, A., Schneider, U., Pedreros, D., McNally, A., Arsenault, K., Harrison, L., & Shukla, S. (2020). Algorithm and data improvements for version 2.1 of the Climate Hazards Center's InfraRed Precipitation with Stations data set. In Satellite precipitation measurement (pp. 409–427). Springer. https://doi.org/10.1007/978-3-030-24568-9_23 pubs.usgs.gov
4. Hu, Z., Zhou, Q., Chen, X., Qian, C., Wang, S., & Li, J. (2017). Variations and changes of annual precipitation in Central Asia over the last century. International Journal of Climatology, 37(S1), 157–170. https://doi.org/10.1002/joc.4988 Wiley Online Library

© 2026 Worldly Knowledge.

Mualliflik huquqi egasi tomonidan ushbu material Creative Commons Attribution 4.0 (CC BY 4.0) litsenziyasi asosida tarqatiladi.

5. Guan, X., Yao, J., & Schneider, C. (2022). Variability of the precipitation over the Tianshan Mountains, Central Asia. Part I: Linear and nonlinear trends of the annual and seasonal precipitation. International Journal of Climatology, 42(1), 118–138. https://doi.org/10.1002/joc.7235 Wiley Online Library
6. Guan, X., Yao, J., & Schneider, C. (2022). Variability of the precipitation over the Tianshan Mountains, Central Asia. Part II: Multi-decadal precipitation trends and their association with atmospheric circulation in both the winter and summer seasons. International Journal of Climatology. https://doi.org/10.1002/joc.7236 Wiley Online Library
7. Zou, S., Abuduwaili, J., Duan, W., Ding, J., De Maeyer, P., Van de Voorde, T., & Ma, L. (2021). Attribution of changes in the trend and temporal non-uniformity of extreme precipitation events in Central Asia. Scientific Reports, 11, 15032. https://doi.org/10.1038/s41598-021-94486-w Scientific Reports
8. Intergovernmental Panel on Climate Change. (2022). Asia. In Climate change 2022: Impacts, adaptation and vulnerability (Chapter 10). Cambridge University Press.

© 2026 Worldly Knowledge.

Mualliflik huquqi egasi tomonidan ushbu material Creative Commons Attribution 4.0 (CC BY 4.0) litsenziyasi asosida tarqatiladi.