American Journal of Interdisciplinary Research and Development
ISSN Online: 2771-8948
Website: www.ajird.journalspark.org
Volume 53, June - 2026

GEOGRAPHICAL LOCATION FEATURES OF WIND DIRECTIONS AND TYPES OF ANCIENT HYDRAULIC STRUCTURES

Asror Nizamov
Professor, Department of Geography and Fundamentals of Economic Knowledge,
Nizami National Pedagogical University of Uzbekistan,
Doctor of Geographical Sciences (DSc), Tashkent, Uzbekistan
Tel: +998 97 872 56 06
Email: a.nizamov56@gmail.com

Abstract
This article provides a detailed analysis of the geographical location features of wind directions and the distribution patterns of ancient hydraulic structures. The study explains how wind regime, relief, solar radiation, aridity and aeolian processes influenced the placement, architectural form and protective functions of ancient water-management facilities in Uzbekistan.

Keywords: Mirzachol, Sangzor, Chirchik, Zarafshan, Fergana Valley, Tomdi, Buzaboy, relief, Khalifa Khudoidad sardoba, plain, wind direction, aeolian deposits, ancient hydraulic structures, sardoba.

Introduction

As reflected in the map entitled “Patterns of the Distribution of Ancient Hydraulic Structures in Uzbekistan in Relation to Climatic Elements”, winds across the territory blow throughout the year from the north-western, northern and north-eastern directions at different speeds. In the foothill and mountainous areas located in the eastern part of the republic, the influence of relief modifies wind direction, and mountain-valley winds and foehn-type winds are more common.

According to the data of the Main Hydrometeorological Administration of Uzbekistan, the average annual wind speed in the territory of the republic is generally not very high. In particular, it is around 3–4.6 m/s across the plains, while in the foothill zone it does not exceed 3 m/s. Strong winds, with speeds exceeding 15 m/s, occur in plain areas up to 11 days per year. In foothill areas, such as Mirzachol, the western part of the Fergana Valley, the parts of the Sangzor Valley adjoining Mirzachol, and Bulungur, strong winds are observed, and the number of days with wind speeds exceeding 15 m/s may reach up to 64 per year. For example, this indicator is 15 days in Termez, 24 days in Jizzakh, 39 days in Kokand, 47 days in Khavos, and so on.

Strong winds also occur periodically in desert areas. For example, in the Kyzylkum region, around Tomdi and Oyokogitma, wind speeds of up to 48 m/s have been observed many times. Winds of this speed may occur up to 30 days per year (G.N. Leukhina et al., 1996, p. 18). Most such strong winds in deserts are accompanied by sand and dust storms. However, many dust storms are more often observed when wind speed is below 10 m/s; nevertheless, they transport large quantities of dust particles from one place to another. As a result, small water bodies in desert areas become additionally saturated with dust and sand particles, most of which contain salts, and their drinking-water quality declines. Between 1975 and 1978, the number of dust storms ranged from 10 in Tomdi and Buzaboy to 95 toward Buzaboy (E.N. Smirnova, O.L. Babushkin, 2009, p. 101). This indicator is increasing even further in the present period.

By the year 2000, under the influence of wind, 15–75 million tons of sand, dust and salt particles had been lifted into the atmosphere from desert areas and spread over a radius of up to 500 km.

If we assume that the intensive movement and accumulation of aeolian deposits also occurred actively in historical periods, it becomes easy to understand how important sardobas and mash'aldon-type structures, which belong to the group of ancient hydraulic structures designed for collection, storage and protection, were in protecting local drinking-water reserves from the influence of wind and wind-borne sediments.

As shown on Map No. ____ entitled “Geographical Distribution of Types of Ancient Hydraulic Structures in Uzbekistan in Relation to Climatic Elements”, the ancient hydraulic structures belonging to this group are located mainly in desert areas that are strongly affected by winds blowing from the north-west, north and north-east. Therefore, among the ancient hydraulic structures classified as “collection and storage facilities”, sardobas alone number 12 in the Mirzachol area, 16 in the Kyzylkum and adjacent territories, 26 in the Karshi Desert, and 1 on the Ustyurt Plateau.

There are also local winds in the republic, such as “garmsel”, “Afghan”, “foehn”, “Bekabad” and “Kokand”, whose speeds range from 15–20 m/s to 30–40 m/s. They exert a strong influence on Surkhandarya, Chirchik, Zarafshan, the Fergana Valley and Mirzachol. Their transport capacity is high, and in order to protect water sources from the aeolian materials they bring, mash'aldon structures became significant. Their very simple and simple types were formed in sparsely populated desert or mountainous areas, whereas complex, varied and richly decorated types were established in and around densely populated cities such as Bukhara, Samarkand, Kokand, Khiva and Termez.

One of the most important factors shaping the climate of our republic is its geographical location and the solar radiation formed in connection with it. This circumstance is reflected in the types of ancient hydraulic structures found across Uzbekistan and in the architectural design characteristic of some of them. This feature can be expressed as a climatic-geographical regularity as follows.

In the southernmost parts of Uzbekistan, during the summer months, solar rays fall at an angle of about 76° along the latitude of 37°10′, while in the northern parts they fall at an angle of about 68° (B.A. Aizenshtat, 1973, p. 75). As a result, south-eastern slopes are the sides where solar rays fall more directly, whereas north-western slopes are considered shady slopes, where the rays are refracted and have a weaker effect. Together with this factor, the duration of sunshine and the amount of total solar radiation strongly heat the surfaces of existing open water bodies. Consequently, especially in deserts, shallow pools are affected not only by intense evaporation but also by deterioration in drinking-water quality: they may become covered with scum, undergo souring and fermentation, change colour, and create conditions for the reproduction of various microbes and aquatic insects. Across the republic, this process may continue from 3,095 hours per year in Termez to 2,889 hours in Tashkent. This is because the duration of sunshine and the related amount of total solar radiation change from south to north and from plains toward mountains and higher elevations, depending on the angle of incidence of the rays and cloudiness. Nevertheless, even in the northernmost parts of the republic, the incoming solar radiation can have a sufficiently negative impact on existing open, especially small and shallow, water bodies. In order to prevent and counteract this situation, structures belonging to the collection, storage and protection group, particularly sardobas, are of exceptionally great importance. The structure of their domes and entrance doors was designed precisely from the standpoint of stopping and combating this process. Accordingly, the geographical location of sardobas is characteristic of areas where the sun shines for a long period and its rays fall directly; their architectural structure was also adapted to the local environment in order to protect and preserve the collected water, namely their entrance openings were oriented only toward the north. This uniformity is repeated as an internal regularity in the structure of all sardobas. Although the entrance of some sardobas, such as the Khalifa Khudoidad sardoba in Bukhara, was built facing south, an immediate protective solution was also provided: a double-leaf door was installed. The door remained permanently closed and reflected the sun's rays. A second opening, built opposite to it, faced north and, being equipped with steps, also served as an entrance opening or doorway into the sardoba.

References

1. Azimboev, S.A., & Tokhtaboeva, Kh.T. Temporary streams in Central Kyzylkum and their use in agriculture. In: Regional geographical issues in the Republic of Uzbekistan: problems and solutions. Proceedings of the International Scientific and Practical Conference. NamDU, 2021.
2. Babushkin, L.N. Climate of Uzbekistan. Tashkent: Academy of Sciences of the Uzbek SSR, 1953. 37 p.
3. Baratov, P. Natural Geography of Uzbekistan. Tashkent: O'qituvchi, 1996. 263 p.
4. Baratov, P., Mamatkulov, M., & Rafiqov, A. Natural Geography of Central Asia. Tashkent: O'qituvchi, 2002. 439 p.

5. Beruni, Abu Rayhan. The Great Scholar of the Middle Ages. Tashkent: Fan, 1950.
6. Beruni, Abu Rayhan. Selected Works II. India. Tashkent: Publishing House of the Academy of Sciences of the Uzbek SSR, 1963. 537 p.
7. Beruni, Abu Rayhan. Selected Works I. Tashkent: Fan, 1968. 485 p.
8. Nizamov, A. Beruni as a hydrogeologist. Fan va turmush, 1985, No. 6.
9. Nizamov, A. Springs of Hisor. Tashkent: Mehnat, 1989.
10. Nizamov, A. The problem of the Oqtepasoy reservoir. In: Independence and Geography. Materials of the 4th Congress of the Geographical Society of Uzbekistan. Tashkent, 1995.
11. Nizamov, A. Regular changes in karst waters in South-Western Uzbekistan. Bulletin of the Geographical Society of Uzbekistan, Vol. 20. Tashkent, 1998, pp. 64–68.
12. Nizamov, A. Sardoba. Fan va turmush, 2000, No. 3.
13. Nizamov, A. The role of ancient hydraulic structures in the history of water supply. In: Cultural Heritage of Central Asia. Tashkent: National University of Uzbekistan, 2002.
14. Nizamov, A. The Nurata Spring. Sog‘lom avlod uchun, 2003, No. 4.
15. Nizamov, A., & Sultonova, D. Some problems of the geographical study of ancient hydraulic structures: the case of sardobas. In: Modern Geography: Theory and Practice. Proceedings of the International Scientific and Practical Conference. Tashkent: National University of Uzbekistan, 2006.
16. Nizamov, A. The Raboti Malik Sardoba. Sog‘lom avlod uchun, 2006, No. 8, pp. 24–26.
17. Nizamov, A. Sardoba. Popular-scientific film. Uzbekkino, M.A.T., 2006. 35 minutes.
18. Nizamov, A. Geography of Ancient Hydraulic Structures of Uzbekistan. Tashkent: GIDROLINGEO, 2008. 235 p.
19. Nizamov, A. Beruni’s Hydrological Heritage. Tashkent: Fan va texnologiya, 2018. 99 p.
20. Nizamov, A., & Matnazarov, A.R. Glaciotourism in Uzbekistan. Bookmany Print, 2022. 173 p.