

RESEARCH ARTICLE

Historical-Topographic Analysis Of Population Distribution And Irrigation Systems In The Middle Syr Darya Basin

Sharofiddin Mamatov

Lecturer department of history Gulistan State University, Uzbekistan

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Abstract

This article provides a comprehensive analysis of the natural and geographical conditions of the Middle Syr Darya basin, its water resources, and their close interrelation with historical processes. The study examines the relief, climate, and hydrological characteristics of the middle course of the Syr Darya, as well as the factors influencing the water balance, and reveals the role of this natural environment in the formation of irrigated agriculture and settlement patterns in antiquity and the Middle Ages. Based on archaeological and historical sources, the emergence and stages of development of irrigation systems in the Otrar oasis, Southern Kazakhstan, Tashkent, and the Mirzachul regions are analyzed, along with their impact on rural and urban culture. In addition, the spatial distribution of irrigation facilities and settlements is examined using aerial photography and the results of modern archaeological research. The findings highlight the historical significance of water resources and irrigation systems as key factors in the socio-economic development of the Middle Syr Darya basin.

KEYWORDS

Middle Syr Darya basin, natural and geographical conditions, irrigation systems, irrigated agriculture, ancient farming, rural settlements, Otrar oasis, Southern Kazakhstan, archaeological research, aerial photography.

INTRODUCTION

Central Asia has historically been characterized by complex natural and geographical conditions, which have played a significant role in shaping socio-economic and cultural processes in the region. In this context, the basins of major rivers—most notably the Amu Darya and the Syr Darya—have functioned as the principal zones of regional development. From antiquity, irrigated agriculture, sedentary settlements, and urban culture emerged and evolved around these rivers, with their development being closely intertwined with water resources and the surrounding natural environment.

The Syr Darya, as one of the largest water arteries of Central Asia, has been particularly influential in determining the

historical trajectory of the oases located along its middle course. The Middle Syr Darya basin encompasses extensive areas including the Tashkent oasis, Mirzachul, Otrar, and Southern Kazakhstan. This region is distinguished by diverse natural conditions, favorable water supply opportunities, and a strategic geographical location. Consequently, from early periods onward, it became one of the most densely populated areas, where irrigation-based forms of economic activity developed extensively.

The natural and geographical conditions of the Middle Syr Darya basin—especially its semi-arid and arid climate, uneven distribution of precipitation, and high rates of evaporation—

necessitated the rational use of water resources. As a result, during antiquity and the Middle Ages, various types of irrigation systems were constructed in the region, including main canals, branched networks, dams, and other hydraulic structures. These irrigation networks not only ensured the development of agriculture but also played a decisive role in determining the location of rural and urban settlements and shaping their economic potential.

In recent years, archaeological research—particularly the application of aerial photography and remote sensing methods—has enabled a comprehensive study of ancient irrigation systems and settlements in the Middle Syr Darya basin. These investigations have led to the identification of numerous previously unknown rural and urban sites and have produced important scholarly conclusions regarding their spatial distribution, chronology, and economic activities. In this regard, the study of the interrelationship between natural and geographical conditions, irrigation systems, and settlement patterns in the Middle Syr Darya basin constitutes an urgent scholarly task essential for a deeper understanding of the region's history.

The primary objective of this article is to analyze the natural and geographical characteristics of the Middle Syr Darya basin, to examine the formation and stages of development of irrigated agriculture under these conditions, and to elucidate, on a scientific basis, the role of irrigation systems in the development of rural and urban culture.

METHOD

This study employs a multidisciplinary approach to examine the natural and geographical conditions of the Middle Syr Darya basin, the development of irrigation systems, and settlement patterns. The research is based on historical-analytical and historical-geographical methods, using written sources and archaeological data to identify the main stages of irrigation and agricultural development. Archaeological evidence, including material culture remains and irrigation traces, is analyzed to reconstruct economic activities and settlement chronology. Aerial photography and remote sensing methods are used to identify ancient irrigation networks and settlement locations. Comparative analysis with other Central Asian regions and systematic synthesis are applied to reveal the relationship between environmental factors, irrigation systems, and socio-economic processes.

RESULTS

Recent archaeological research has increasingly demonstrated that irrigated agriculture played a decisive role in the emergence of the earliest permanent settlements—villages—in the history of human civilization. The study of village settlements that formed the foundation of many irrigated agricultural centers in Central Asia, as well as the identification of their distinctive development trajectories and dynamics, constitutes an important task in illuminating the history of the region. Long-term investigations of ancient irrigated villages in Khorezm, Sogdiana, the Fergana Valley, Tashkent, and Ustrushana, together with the study of village remains in the Middle Syr Darya basin, show that the development of rural settlements in these areas during antiquity and the Middle Ages possessed specific characteristics. These features are determined by a combination of both geographical and historical factors.

It has been established that villages which achieved a high level of cultural and economic prosperity were able, in one way or another, to play a role in the socio-economic evolution of major urban centers. Identifying the role and significance of rural settlements in the socio-economic development of oases is particularly important for a comprehensive study of the history of village settlements in the Otrar oasis. At present, as a result of long-term archaeological research conducted by A. N. Bernshtam, A. Kh. Margulan[1], E. I. Ageeva, G. I. Patsevich[2], K. A. Akishev, K. M. Baipakov[3], L. B. Erzakovich[4], M. S. Mershev, T. N. Senigova, N. P. Podushkina[5], V. A. Groshev, S. Zholdasbaev[6], and others, substantial materials on the history of ancient culture in the southern regions of Kazakhstan have been obtained.

At the same time, the history of rural settlements had not previously been the subject of specialized archaeological research. Only the application of modern methods for locating archaeological sites—such as systematic and long-distance aerial photography, visual observations from aircraft, and related techniques—enabled Kazakhstani archaeologists to move beyond the incidental recording of scattered village and urban remains toward large-scale, systematic investigation and mapping. This became possible with the establishment in 1971 of the South Kazakhstan Complex Archaeological Expedition (SKCAE) of the Ch. Ch. Valikhanov Institute of History, Archaeology, and Ethnography of the Academy of Sciences of the Kazakh SSR, led by K. A. Akishev. The primary areas of research for the archaeological and topographical teams included the Otrar oasis, the left and right banks of the

middle course of the Syr Darya, and the northern and southern slopes of the Karatau range.

The current stage in the development of historical scholarship in Kazakhstan is characterized by the accumulation of a vast and diverse body of archaeological material. Under these conditions, it has become possible to move from the identification and documentation of individual sites in Southern Kazakhstan to the comprehensive archaeological study of extensive territories. In this context, Kazakhstani archaeologists carried out large-scale preparatory work using modern survey methods. Systematic and prospective aerial photography and observation from aircraft of most settlements located along the middle course of the Syr Darya made it possible to compile an updated map of agricultural archaeological monuments. In addition to previously known sites, nearly eighty new settlements, habitation sites, and farmsteads were identified. The interpretation of aerial photographs provided valuable information not only on the historical topography of rural settlements but also on the condition and characteristics of irrigation structures. This proved to be a key factor in mapping and describing irrigation networks in detail, as well as in determining their relationship with archaeological sites, relief, and water sources. The effectiveness of aerial photography is so significant that its application in Central Asian archaeology merits special attention.

DISCUSSION

In the mid-1930s, aerial methods began to be applied in archaeological research in Central Asia, associated with the work of prominent archaeologists M. V. Voevodsky and V. A. Shishkin. During the study of ancient irrigation systems in Khorezm, Termez, and Bukhara, the results of systematic and prospective aerial photography and visual observations from aircraft exceeded expectations. Aviation made it possible to detect and document traces of the past that are not visible from the ground, proving especially effective in identifying remains of irrigation systems. Mapping ancient irrigation networks based on aerial photographs represents the most comprehensive, accurate, and objective approach. The Khorezm Archaeological and Geographical Expedition also made extensive use of aerial photography.

Kazakhstani archaeologists turned to aerial photography during fieldwork in Southern Kazakhstan in the summer of 1969. The interpretation of large-scale aerial images of

ancient irrigated lands enabled them to identify several types of ancient irrigation based on the characteristics of the photographs: areal forms (fields, melon plots, vineyards), linear forms (canals, ditches, defensive embankments), and point features (wells, water-lifting installations, and others)[7]. Ultimately, as a result of nearly one thousand observations, more than 500 village sites were recorded, along with approximately 60 urban or large rural settlements.

In these areas, many rural estates were located along the main canal near the settlement of Quyruktobe. During investigations conducted in 1969–1970, it was recorded that these estates had a standardized layout, consisting of the remains of residential and auxiliary buildings as well as an adjacent courtyard. The existence of these estates has been dated to the fifteenth–seventeenth centuries CE.

During land survey work carried out to the east of Otrar, another network of canals branching off and distributing water from the left side of the Temiraryk was identified. Its course can be traced in a northeastern direction as far as the modern settlements of Karagaly and Bayalder.

The ancient Otrar oasis was located in the present-day Kyzylkum district of the former Chimkent Province of the Kazakh SSR. Its territory included both banks of the Syr Darya as well as the confluence of the Aris River, encompassing the entire Aris delta. Its favorable geographical position, abundant water resources, and fertile soils (enhanced through artificial irrigation) were among the key factors that promoted the development of irrigated agriculture in the area. In this regard, A. N. Bernshtam noted that Otrar occupied an advantageous position near the confluence of the Aris and Syr Darya rivers, close to the Bugun River. The Bugun and Aris rivers provided access toward the Talas and Bugun regions and later to the territories of the Karluks. Caravan routes along the Syr Darya had long connected the region with Shash, the Fergana Valley, and Sogdiana.

An important factor contributing to the increase in the share of agriculture in the overall volume of production in this region was its proximity to vast steppe areas. From ancient times, the population of these areas had been engaged in pastoralism and was closely interconnected with the local sedentary population through political, economic, and ethnic relations.

In the past, the scale of economic and cultural development of the Otrar oasis is confirmed by the remains of

approximately sixty settlements and small towns located along preserved canals and branches. In this area, the irrigation group of the South Kazakhstan Complex Archaeological Expedition (SKCAE) identified and studied the earliest forms of irrigation in the form of floodplain lakes and canals situated in the delta branches of the Aris River. According to the research of archaeologist V. A. Groshev, agricultural settlements can be divided into two main groups based on their relationship to water sources: settlements located in the Aris River basin and rural and urban settlements of the Middle Syr Darya basin.

The natural water systems of the two rivers, in turn, made it possible to distinguish four local groups of settlements: (A) agricultural settlements concentrated around Otrar and located along the delta branches on the right bank of the Aris River; (B) villages situated on the left bank of the Aris River in the Kok-Mardan area; (C) rural settlements located along lakes on the right bank of the Syr Darya; and (D) villages concentrated around Oksus on the left bank of the Syr Darya.

The first group of rural settlements occupies the central part of the Otrar oasis. It is bounded by the Aris River to the south and southeast. Remains of an agricultural settlement were identified on the left bank of a canal. Topographically, these sites appear as oval mounds approximately 30 meters in diameter and about 2 meters in height. Archaeological investigations conducted at the site revealed pottery dating to the fifteenth century CE.

Archaeological research carried out in 1969–1970 concludes that the settlements of Group A date to the first half of the first millennium CE. Within the complex of settlements belonging to Group B, fourteen sites were identified, some of which were partially excavated. Aerial photographs clearly show that all sites in this group were located along canals, and in several cases the presence of canals and small irrigation systems was documented.

Group D is located on the opposite left bank of the Syr Darya, in the Oksus area, within the Akzhar tract. Researchers identified a total of about one thousand irrigation canals in this area, along which eight rural settlements were located. The pottery assemblages identified through archaeological research are characteristic of ceramic complexes typical of agricultural settlements in the middle course of the Syr Darya and the river valley during the corresponding periods.

Thus, on the basis of pottery assemblages discovered at the

Shaushukumtobe, Aktobe, and southern Kostobe sites, which are topographically associated with delta canals and floodplain lakes, it has been established that the origin of irrigation in the Otrar oasis dates to the first–sixth centuries CE.

Aerial photographs show that the entire area surrounding the settlements of Quyruk and Altin is covered with traces of the fan-shaped canals of the Sangylaryk irrigation system, with the spaces between them filled by ancient fields. These agricultural irrigation systems formed vast, continuous cultivated areas situated between the canals.

Based on the presence of settlements and villages located along the channels of the Sangylaryk system, as well as the pottery assemblages collected in this area, the Sangylaryk system has been dated to the seventh–ninth centuries CE.

In 1980–1981, the research was continued and extended to include the ancient irrigated lands on the left bank of the Middle Syr Darya, from Chardara to Akkurgan. As a result of these survey activities, more than fifteen archaeological sites were identified. Among them were Sutkent, Jartobe, Kaugannata, Buzuk, Aktobe, Kandoz, Karatobe, Abiztobe, Kumiyan, Kelintobe, Meyramtobe, Kotan, Akkurgan, Argikara, as well as a number of smaller rural settlements.

Thus, during the ninth to twelfth centuries, the development of productive forces ensured a new phase in the expansion of irrigation in the Otrar oasis. Advances in irrigation technology and the expansion of irrigation networks contributed to the economic consolidation of rural and urban settlements and to the flourishing of crafts and trade. The urban landscape changed as craft quarters (rabad) expanded around cities, while rural estates were arranged along irrigation canals. The growth of productive forces ultimately led to social stratification and to the separation of agricultural labor from crafts and trade.

On the other hand, archaeological excavations conducted within the territory of fortified settlements revealed faint traces of irrigation canals and fields representing the remains of nearby agricultural irrigation systems. Such rural settlements—small in size and characterized by planned rectangular, oval, double-oval, and irregular rectangular layouts—have survived in Kazakhstan up to the present day. Monuments attesting to the agricultural activities of the ancient population of Otrar have been preserved as a result of aerial photography and systematic survey investigations.

In the second half of the first millennium BCE, the village

settlements of the Saka tribes, which were widespread in the Aral Sea region (such as Chirik-Rabat, Bobish-Mulla, and Balandy), functioned on the basis of floodplain (liman) irrigation systems. At the beginning of the Common Era, representatives of the Jety-Asar culture, which formed in the lower reaches of the Syr Darya due to natural environmental conditions, initiated a new wave of development in the region through the improvement of floodplain irrigation systems. Nevertheless, the delta-based irrigation method continued to be maintained. As an example, near Barak-Tom on the banks of the Akchadarya, a main water-distribution structure was constructed that connected three major channels into a single canal. The emergence of large irrigation canals and substantial water reservoirs in the lower Syr Darya course led, in turn, to the formation of the earliest rural settlements within the basins of these canals.

By the medieval period, certain changes in the construction of main irrigation canals can be observed in the area of the Jend settlement. In the eleventh to thirteenth centuries, Jend served as a frontier outpost on the northeastern border of the Khwarazmshah state, and during the period of Mongol rule it became the residence of Jochi Khan. The main canal that irrigated the surrounding fields and gardens had a channel width of 6–7 meters and a depth of about 4 meters.

The settlement itself controlled irrigation systems originating from the Jendar'ya River. Other settlements were located around it, with their estates distributed among fields, melon plots, and gardens. The gardens were laid out in rectangular plots and occupied large areas of up to 2 hectares.

Numerous traces of medieval irrigation have also been recorded in the Upper Inkardarya region of the Saritam area. Here, around many pottery sites, the remains of a dense network of irrigation canals—up to 12 meters wide—have been preserved, which supplied water to extensive areas of fields and melon plots. All villages in this area were located along canals, and in some places canals and small-scale irrigation systems were constructed.

In the Middle Syr Darya basin, changes in irrigation systems occurred by the medieval period as a result of the deepening of river channels. This process led to the formation of irrigation systems that made use of precipitation and surface runoff. Such a pattern can be observed along a distance of approximately 3 km from the Aris River to the settlement of Kok-Mardan. Here, the canal generally follows the overall slope of the terrain and typically flows in a northwestern

direction. The width of the canal varies from 5 to 20 meters in its winding sections, and as it approaches Kok-Mardan it encircles the settlement, forming a natural water barrier. Approximately ten archaeological sites and rural settlements are located in this area.

All settlements in this zone are situated around large lakes of the Syr Darya, and their canals are relatively wide. The Akzhar canal follows a meandering course exceeding 30 km in length; it was formed by the river and gradually changes its direction from northwest to southwest. Because the relief of this area is relatively flat, it contains a network of ravines, abandoned canals, shallow lakes, and floodwater meadows. The irrigated plots surrounding the villages vary in shape and size: rectangular plots measure approximately 5 × 9 m, while square plots measure about 6 × 7 m or 8 × 8 m.

CONCLUSION

The Middle Syr Darya basin represents one of the most significant natural, geographical, and socio-economic regions in the history of Central Asia during antiquity and the Middle Ages. The results of this study demonstrate that the natural environment of the region—particularly its semi-arid climate, the seasonal character of water resources, and the specific features of river systems—played a decisive role in the emergence and development of irrigated agriculture. Irrigation systems not only ensured agricultural production but also fundamentally shaped settlement patterns, economic specialization, and the social structure of rural and urban communities.

Archaeological and historical evidence indicates that irrigation systems in the Otrar oasis and the Middle Syr Darya basin began to take shape as early as the first–sixth centuries CE, underwent significant development during the seventh–ninth centuries, and reached their peak between the ninth and twelfth centuries. These processes were closely linked to the growth of productive forces, the economic consolidation of villages and cities, and the expansion of crafts and trade. The extension of irrigation networks integrated rural estates, cultivated fields, and gardens into unified economic systems, creating the foundation for the sustained economic and cultural prosperity of the oases.

The application of modern archaeological methods, particularly aerial photography and remote sensing, has made it possible to conduct a comprehensive study of ancient irrigation systems and settlement sites in the Middle Syr Darya

basin. This approach has led to the identification of numerous previously unknown rural and urban sites and has refined our understanding of their spatial organization, chronology, and economic functions.

Overall, the analysis of the relationship between irrigation systems and settlement development in the Middle Syr Darya basin provides important insights into the historical dynamics of the region, the economic foundations of ancient and medieval societies, and the broader patterns of civilization development in Central Asia. The findings of this study offer a solid scholarly basis for future historical-geographical and archaeological research in the region.

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