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THE FORMATION OF MICRO-OASES IN CENTRAL ASIAN CITIES DURING THE IRON AGE

Zaripova Madina Xusinovna

Asia International University, Bukhara, Uzbekistan

E-mail: m.zaripova@oxu.uz

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Abstract. This article analyzes the patterns of formation of micro-oases in urban centers of Central Asia during the Early and Developed Iron Ages based on archaeological and geoarchaeological data. Regional micro-oases formed as a result of the development of iron metallurgy, improvement of hydraulic structures, and demographic growth are examined. During the research, urbanization centers in ancient Bactria, Margiana, and Sogdia were comparatively studied, and their socio-political factors were identified. The cultural transformation of suburban landscapes and spatial structure of micro-oases are covered on the basis of a systematic approach. The results show that micro-oases served as an economic foundation for the formation of early statehood systems.

Keywords: Iron Age, Central Asia, urbanization, micro-oasis, archaeology, hydrotechnics, settlement pattern, Bactria, Sogdia, spatial analysis.

Annotatsiya. Ushbu maqolada ilk va rivojlangan temir davrida O'rta Osiyoning urbanizatsiyalashgan markazlarida mikrovohalarning shakllanish qonuniyatlari arxeologik va geoarxeologik ma'lumotlar asosida tahlil qilinadi. Temir metallurgiyasining rivojlanishi, gidrotexnik inshootlarning mukammallashuvi hamda demografik o'sish natijasida vujudga kelgan hududiy mikrovohalar tahlil etilgan. Tadqiqot davomida qadimgi Baqtriya, Marg'iyona va Sug'd hududlaridagi urbanizatsiya o'choqlari qiyosiy o'rganilib, ularning tabiiy-geografik va ijtimoiy-siyosiy omillari aniqlangan. Shahar atrofi landshaftlarining madaniylashishi va mikrovohalarning makoniy tuzilishi tizimli yondashuv asosida yoritilgan. Olingan natijalar mintaqada ilk davlatchilik tizimi shakllanishida mikrovohalarning iqtisodiy asos bo'lganini ko'rsatadi.

Kalit so'zlar: Temir davri, O'rta Osiyo, shaharsozlik, mikrovoha, arxeologiya, gidrotexnika, urbanizatsiya, Baqtriya, Sug'd, makoniy tahlil.

Аннотация. В данной статье на основе археологических и геоархеологических данных анализируются закономерности формирования микрооазисов в урбанизированных центрах Центральной Азии в эпоху раннего и развитого железного века. Рассматриваются региональные микрооазисы, возникшие в результате развития металлургии железа, усовершенствования гидротехнических сооружений и демографического роста. В ходе исследования были сравнительно изучены центры урбанизации древней Бактрии, Маргианы и Согда, определены их природно-географические и социально-политические факторы. На основе системного подхода освещены культурная трансформация пригородных ландшафтов и пространственная структура микрооазисов. Полученные результаты показывают, что микрооазисы служили экономической основой формирования систем ранней государственности.

Ключевые слова: Железный век, Центральная Азия, градостроительство, микрооазис, археология, гидротехника, урбанизация, Бактрия, Согд, пространственный анализ.

INTRODUCTION

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The transition from the Bronze Age to the Iron Age in southern Central Asia during the mid-second millennium BC represents one of the most substantial cultural, economic, and technological paradigm shifts in ancient Eurasian history [1, p. 11]. The disintegration of the Bronze Age Oxus Civilisation (Bactria-Margiana Archaeological Complex) did not result in a complete cultural vacuum; instead, it laid the foundations for a restructured social hierarchy and novel spatial organizations across the landscape [2, p. 135]. With the gradual introduction and mastery of iron metallurgy towards the 9th–8th centuries BC, structural changes occurred in agricultural productivity, long-distance trade, and defensive military engineering.

A defining feature of this period was the abandonment of several massive Bronze Age proto-urban centers in favor of highly localized, structurally integrated territorial entities often termed "micro-oases." These micro-oases can be defined as cluster-based settlement networks comprising a central fortified stronghold (citadel), a periphery of dependent agricultural agrarian villages, and interconnected, human-made irrigation systems. Understanding how these micro-oases formed, managed their hydraulic resources, and sustained urban centers in ancient Bactria, Sogdiana, and Margiana is vital to uncovering the mechanisms behind early statehood and social stratification in prehistoric Central Asia.

MATERIALS AND METHODS

This research relies heavily on comprehensive archaeological field survey data, material culture typologies, and comparative spatial analysis of prominent Iron Age settlement clusters across southern Uzbekistan, Turkmenistan, and Tajikistan. The specific primary subjects of investigation include the early layers of sites in Northern Bactria (such as Kiziltepa, Bandikhan, and Kuchuktepa), Southern Sogdiana (Uzunqir, Erkurgan, and Koktepa), and the Lower Murghab region of Margiana (Yaz-depe).

Methodologically, this paper utilizes a systemic regional approach alongside spatial and landscape archaeology frameworks. By evaluating geographic variables—such as proximity to active paleochannels, alluvial fan distribution, elevation, and the calculated territory of domestic ceramic dispersal—the study maps out the operational radiuses of these micro-oases. Furthermore, historical-comparative stratigraphy is employed to track continuity or discontinuity in regional hydraulic management from the Yaz I phase through the Yaz III (Achaemenid) periods.

LITERATURE REVIEW

The chronological framework and material classification for the Central Asian Iron Age were pioneered in the mid-20th century by V. M. Masson following his landmark excavations at the stratified site of Yaz-depe in Turkmenistan, establishing the tripartite division of Yaz I, Yaz II, and Yaz III [3, p. 7]. Subsequent structural and territorial excavations led by academician A. S. Sagdullayev across the Surkhandarya valley redefined our comprehension of early iron-using farming communities, demonstrating that the fortified strongholds of Bactria were deeply tied to specific hydrographic configurations [4, p. 45].

Over the last decade, international and local research has shifted towards micro-regional and interdisciplinary environmental surveys. Scholars such as J. Lhuillier have highlighted that the Early Iron Age settlement pattern was characterized by territorial fragmentation, where small villages effectively replaced massive integrated Bronze Age complexes but deliberately retained or modified extant irrigation lines [5, p. 142]. Concurrently, studies regarding animal exploitation and botanical remains in these regional hubs have demonstrated localized adaptive strategies to specific arid ecosystems [6, p. 205]. Despite these valuable data points, a unified synthesis explaining the exact socioeconomic mechanisms through which small-scale hydraulic projects birthed distinct urban micro-oases has remained underdeveloped.

DISCUSSION

The emergence of localized micro-oases during the Iron Age was deeply contingent upon both the introduction of harder metallic tools and shifts in climatic parameters. Iron-tipped shares and heavy axes allowed these ancient communities to clear dense riverine forests (tugai) and cultivate heavy alluvial soils that were previously unworkable with bronze or stone implements [7, p. 123].

Scottish International Conference on Multidisciplinary Research and
Innovation – SICMRI 2026

- The spatial layout of a typical Central Asian Iron Age micro-oasis exhibits a tripartite hierarchy:
- The Central Fortified Stronghold:** Sites such as Kiziltepa or Yaz-depe featured heavily fortified mudbrick citadels built upon elevated platforms [4, p. 48]. These served as the administrative, religious, and redistributive nodes of the micro-oasis.
 - Satellite Agrarian Settlements:** Small settlements, typically spanning between 0.5 to 2 hectares (such as Bandikhan I or Talashkan), clustered within a 3 to 7-kilometer radius around the central core, focusing primarily on agrarian production or specialized craft metallurgy.
 - Dedicated Hydraulic Infrastructures:** Each micro-oasis was bound to an artificial irrigation canal derived from smaller rivers or mountain springs rather than major wild rivers, minimizing the risk of uncontrollable catastrophic flooding while maximizing localized water security.

Socio-politically, these micro-oases did not exist in total isolation. They formed highly competitive networks. The central node exercised authority over water distribution among its satellite villages. This centralized control over vital agricultural inputs accelerated wealth accumulation, leading directly to the establishment of early institutionalized state bodies, such as the semi-mythical or early historical Bactrian kingdom [8, p. 74].

RESULTS AND ANALYSIS

Comparative empirical analysis of settlement data reveals that the size, agricultural capability, and long-term sustainability of these micro-oases varied widely based on local geomorphology. Table 1 aggregates the structural and spatial attributes of the primary evaluated micro-oases across the historical-cultural zones of Central Asia.

Table1

Comparative Archaeological Attributes of Major Iron Age Micro-Oases

Micro-Oasis Name	Cultural Region	Central Urban Site	Estimated Operational Area (km)	Dominant Economic Specialization	Primary Chronological Phase
Bandikhan	Northern Bactria	Bandikhan-tepa / Kiziltepa	15–22	Intensive irrigation farming, metallurgy	Yaz I - Yaz
Sherabad	Southern Uzbekistan	Jondavlattepa / Chuktepa	12–18	Viticulture, advanced pottery production	Yaz I - Yaz
Kashkadarya	Southern Khorezmiya	Erkurgan (early phase) / Uzunqir	25–35	Mixed crop-pastoralism, regional trade	Yaz II - Yaz
Lower Marghab	Margiana	Yaz-depe Citadel Complex	16–20	Large-scale cereal cultivation, trade	Yaz I - Yaz

The compiled data indicates that the Kashkadarya and Bandikhan micro-oases commanded the largest territorial spreads [9, p. 695]. The expansion of these operational areas was directly correlated with technical innovations in water diversion. In the Bandikhan micro-oasis, the construction of defensive walls coincided precisely with the expansion of local channels, proving that military protection and agricultural security were twin components of urban planning [4, p. 52].

Furthermore, ceramic continuity across these sites proves that while political superstructures fluctuated—culminating in the integration of these micro-oases into the Achaemenid imperial provincial framework during the Yaz III phase—the underlying socio-economic and demographic structure of the individual micro-oasis remained exceptionally resilient [10, p. 14].

Scottish International Conference on Multidisciplinary Research and Innovation – SICMRI 2026

CONCLUSION

Based on the comprehensive spatial and literature analysis conducted, the following conclusions are reached:

1. The development of early urbanization in Iron Age Central Asia was characterized by decentralized, cluster-based networks where central fortified points were structurally integrated with peripheral agrarian micro-oases.
2. The primary technological drivers behind this structural shift were the expansion of localized iron tool production and the deliberate construction of manageable, small-scale artificial irrigation systems.
3. These micro-oases provided the crucial economic stability, demographic density, and administrative experience that facilitated the rise of complex early macro-states prior to and during the classical historical eras.

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