Irrigating the desert: water management, agricultural practices, and social complexity in Southern Turkmenistan during the Bronze Age

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Chapter 3 – The Archaeological Context and Theoretical Framework

3.1 BMAC Origins and the Broader Context

- **Ancient Designation of the BMAC Region**

The term "Bactria-Margiana Archaeological Complex" was first coined by Sarianidi to identify the area that spans what is now eastern Turkmenistan, northern Afghanistan, and southern Uzbekistan. More recently, as introduced in Chapter 1, Biscione and Vahdati (2021) coined the term "Greater Khorasan Civilization" (GKC), which has recently been used by other authors (Kroll et al. 2002; Cerasetti and Luneau, forthcoming). In addition to the region's modern denomination, its ancient name also remains nebulous. Over the last two decades, different authors have tried to establish an identification in Mesopotamian texts for the BMAC region. Potts (2008) has suggested that the land of Shimashki (*Šimaški*), mentioned in some Mesopotamian texts, might be the BMAC region. By contrast, Francfort and Tremblay (2010) argue that the region of Marhashi (*Marhaši*) corresponds to the BMAC. The region of Marhashi is known to be one of Akkad's main eastern enemies, eventually becoming an economic partner (Guichard 2021:73–75). Other authors identify Marhashi with the *Halil Rud Civilization* in the south-eastern Kerman Province of Iran rather than the Margiana (Steinkeller 2006). More recently, Steinkeller (2016:129) has tentatively tried to link the BMAC region with Tukrish (*Tukriš*), considering that this country was the possible source of lapis lazuli and gold for Mesopotamia. Overall, although direct or indirect *contact* between Mesopotamia and northeastern Iran and southern Turkmenistan is evident from the archaeological record, there is no consensus as to its ancient name in the textual sources (Mutin and Lamberg-Karlovsky 2021; Guichard 2021).

- **The Chalcolithic and Early Bronze Age in the Murghab: Patchy Evidence**

Evidence of earlier occupation prior to the Middle Bronze Age in the Murghab region has been limited to isolated discoveries. Painted surface sherds (of Geoksyur type) dated to

the Middle and Late Chalcolithic (Namazga II and III periods – ca. 3500–2800 BCE) have been found north of Kelleli, in sites described by Masimov (1979) as seasonal campsites. In addition, Massimov also reports that in the basal level of Kelleli 1, carinated greyware was found that may suggest an occupation preceding the Middle Bronze Age. At Gonur North, two sherds and three radiocarbon dates fall into the Geoksyur-Chalcolithic period (Lyonnet and Dubova 2021a:20). Additionally, possible evidence of an early occupation is available from the fortified site of Adji Kui 9, northwest of Gonur, where painted ceramics, probably dating to the late 4th to early 3rd millennium BCE have been found (Rossi-Osmida 2007:124). At this site, moreover, Salvatori (2002) dated Unit 17a from the deep sounding to the Middle–Late Chalcolithic period. Similarly, at Gonur North, short-term occupation and narrow walls have been found, suggesting that the site was probably sporadically occupied before the Middle Bronze Age (Sataev 2018).

Further south in the alluvial fan, Lyapin (2014) reports Namazga III pottery at a depth of 4.5–6 m. The amount of alluvial deposition might have therefore obscured archaeological evidence from the Chalcolithic period in the northern fringe (Hiebert 1994a; Salvatori 2008a). However, the deposition of alluvium in the north of the fan is quite reduced compared to that in the south, and very often Bronze Age materials appear after a few centimeters of excavation. Nevertheless, Chalcolithic evidence remains elusive and underrepresented in the Murghab landscape. In contrast, Chalcolithic occupations in the nearby Kopet-Dag region are numerous (Kircho 2021).

A possible explanation for this absence might be the limited occupation of the Murghab region during the late 4th to early-middle 3rd millennium BCE, while it is only in the late 3rd millennium that numerous sites started to appear in the region along with intense urbanization. But what was the origin of this phenomenon?

- **The Origin of the BMAC**

Several authors have considered the BMAC to have derived from the Namazga culture in the Kopet-Dag, postulating a colonization of the Murghab during the Middle Bronze Age (2400–1950 BCE) (Masson 1988:92; Biscione 1977). During this period, the Kopet-Dag communities were in contact with neighboring societies such those in the Indus (Masson 1988: pl. XXII, 2 and 5*)*. Likewise, contact is attested between communities of southern Turkmenistan and societies in northeast Iran to the south, and communities in Uzbekistan and Tajikistan to the east for instance. A metal stamp seal of a type deriving from southern Turkmenistan was found at Tepe Hissar (IIIB levels) in northeastern Iran (Schmidt 1937:Fig. 118, H 2697). Similarly, artifacts that have been found at the site of Altyn-Depe in the Kopet-Dag are comparable to objects from Hissar IIIB (Schmidt 1937:pl. LXI H 2895, LXIV H 2894). Objects deriving from the southeast of Iran are also known. Further, materials found in burials at Altyn-Depe, such as beads, resemble objects from central-east Iran at the Shahdad cemetery (Kircho 2021:133).

Contact is attested with eastern regions as well. Materials found in the lower Zeravshan in Uzbekistan (Guljamov et al. 1966), and in southern Tajikistan, show the presence of Namazga IV and early Namazga V materials (see Table 1.1 for correspondence chronology) (Vinogradova 2021). These interregional contacts with neighboring regions increased during the late 3rd millennium BCE, which marks the floruit of the BMAC (Kircho 2021:134; Mutin and Lamberg-Karlovsky 2021). Thus, during the Early and Middle Bronze Age periods (2800–1950 BCE), communities in the southern Turkmenistan region were interconnected through various networks.

Similarities between Kopet-Dag and the Murghab assemblages can be found in ceramics and iconographic objects, such as the violin-shaped figurine found at Altyn-Depe (Masson 1988:pl. IX; cfr. Rossi-Osmida 2007:183). In this context, as discussed in Chapter 1, it has recently been suggested by Biscione and Vahdati (2021:527) that the Kopet-Dag area, including parts of northeastern Iran, can be considered the “formative” area of the BMAC.

In contrast, Sarianidi has proposed a theory in which the rise of the BMAC occurs as a result of the migration of tribes from the Levant and Mesopotamia (Sarianidi 2009:41–42). According to Sarianidi (2002:78) this is visible in the architecture and specific traditions of monumental buildings. For instance, the throne hall (room 196) of the Gonur palace finds its parallel, according to the author, in the location of the throne in the palace of Mari in Mesopotamia (Sarianidi 2002:79). However, this evidence is meagre and difficult to support.

Similarities between BMAC material culture and that of other regions are at the base of further migration theories. The BMAC has been linked to migration from the Baluchistan region, or Aral Sea region and the Eurasian Steppe (Lamberg-Karlovsky 2003; Alyekshin 1980; Kohl 2002:167-169). This latest hypothesis, however, contrasts with the assemblages from the "steppe" in the Murghab, which are from the first half of the 2nd millennium BCE onwards, thus after the floruit of the BMAC (Cattani 2008b).

Although migration theories alone do not explain the emergence of the BMAC, the movement of the population cannot be ruled out. Recent aDNA analysis indicates the presence of individuals with diverse origins at BMAC sites, while the isotopic analysis from the site of Ulug Depe suggests possible migrations during the Bronze Age (Narasimhan et al. 2019; Kroll et al. 2022). Nevertheless, mass "migration" from distant regions is not supported by archaeological data but, in contrast, movement of individuals or groups likely occurred.

At present, the origin of the BMAC, as well as the absence of early occupation in the region, remains problematic. Although the origins of the BMAC are beyond the present research, I argue that on the basis of the current data the emergence of the BMAC in the Murghab should be understood as an endogenous phenomenon within the wider interregional context of cultural and economic interaction that characterize southern Turkmenistan during the 3rd millennium BCE, and that its roots are more likely in the Namazga culture of southern Central Asia.

3.2 Settlement Systems and Architecture in the Murghab Region

The sites of the Murghab region have been grouped by Soviet scholars into nine main clusters (i.e., Egri Bogaz, Kelleli, Taip, Adji Kui, Auchin, Gonur, Adam Basan, Togolok, and Takhirbaj). These sites were located along the main river branches of the Murghab and were initially understood as "oases" separated by sand dunes (Sarianidi 1981:188; Masimov 1981: 218). This was the first model of the settlement landscape of the region. Subsequent research in the Murghab by the AMMD in the 1990s and 2000s led to a reassessment of the model. The intensive survey by the AMMD team suggested a well-watered and continuous agricultural landscape on the basis of a complex system of hundreds of sites, which contrasted with the theory of isolated oases (Gubaev et al. 1998) (but see section 3.4 in this Chapter for further discussion).

The main sites initially identified by the Soviet archaeologists included dense settlement clusters with fortified structures, such as Adji Kui 9 and Adji Kui 1, located only a few hundred meters apart. This settlement system, which developed during the Middle Bronze Age in the Murghab, was associated with an archaeological assemblage that is also found in Uzbekistan and Tajikistan (along the Amu Darya river) and parts of northern Afghanistan during the second half of the 3rd millennium BCE. This area has been defined as the "core" area of the BMAC and was characterized by specific objects, pottery, luxury materials, and architecture (Luneau 2019; Biscione and Vahdati 2021).

3.2.1 The Middle Bronze Age

The Middle Bronze Age spans between 2400 and 1950 BCE (see section 1.1 in Chapter 1 for a chronological discussion) and is considered the apex of the BMAC, or the "mature phase." At this time, Murghab societies engaged in substantial trade with societies in neighboring regions (Kohl 2007). It has been suggested that during the Bronze Age with the society had social stratification, imposing architecture, and a possible settlement

hierarchy, although lacked a writing system (Salvatori 2008b:93; Lyonnet and Dubova 2021b:24). By contrast, other authors suggest a consolidated state rather than proto-state formations (Hiebert and Lamberg Karlovsky 1992; Hiebert 1994b:176).

3.2.1.1 Architecture, Economy, and the Political System

- **Architecture**

One of the most distinctive features of the BMAC is its architecture. Most of the well-known sites of the Murghab are fortified settlements with rectangular towers along the walls and at the corners, which eventually developed into circular towers during the Late Bronze Age (c. 1950–1500 BCE). One of the early examples is Kelleli 3, which shows a monumental rectangular fortress with an exterior double mudbrick wall and a single occupation phase (Hiebert 1994a:17) (Figure 3.1).

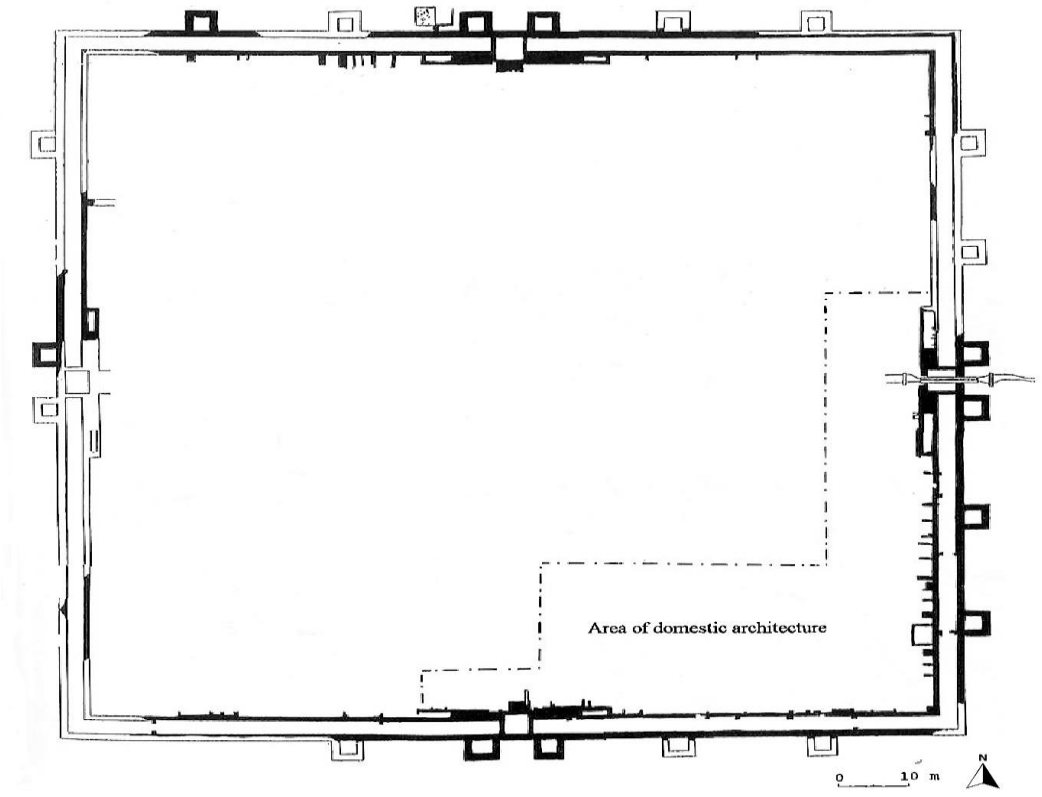


Figure 3.1 Plan of the fortified site of Kelleli 3 (Hiebert 1994:Fig. 2.5).

Similar to Kelleli 3, the Gonur North[19] palace has a double wall and a corridor inside with rectangular towers at the corners. The entrances are located in the middle of the walls and are protected by towers. Within the walls there is a fortified palace structure with a complex system of rooms and corridors (Sarianidi 2008a). Interestingly, the area within the outermost oval perimeter wall and the fortified building contains a water system. The excavators of Gonur North identified various water reservoirs in all phases of the complex in front of the gates (Sarianidi and Dubova 2012). According to Sarianidi, these reservoirs were filled with water from the Murghab River as well as rainwater. The largest water reservoir is located in the southern part of the site, within the external wall, while two smaller water reservoirs were located within the second perimeter wall of the citadel. Further, three more reservoirs are located in the north. According to Sarianidi, most of the water pools inside the main building served religious purposes, but evidence supporting this interpretation is scant. It is also possible that it served domestic needs. An in-depth examination of all the drainage systems and the possible direction of water at Gonur North has never been attempted. Possibly, the largest water reservoir located in the south (Figure 3.2) was fed by a canal(s), as the discovery of an artificial ditch in the southwest of the site seems to suggest (Sataev 2008). This canal is one of the few known examples of an artificial watercourse in the Murghab dated to the Middle Bronze Age.

An additional piece of water infrastructure consisted of ceramic pipes. The pipes are cone-shaped, so that one pipe fits into the other (Figure 3.3). The best-preserved pipes in Gonur North were found in the square of the main entrance of the palace. However, ceramic drainage pipes were also discovered in the south mound of Togolok 1 (period 2) and at Togolok 21. Similar to Gonur North, at Togolok 1, these pipes were possibly used for drainage (Hiebert 1994a:58). These drainage pipes show that BMAC communities were able to design sophisticated water systems.

19 Gonur is divided into Gonur North and Gonur South, respectively dated to the Middle and Late Bronze Age.

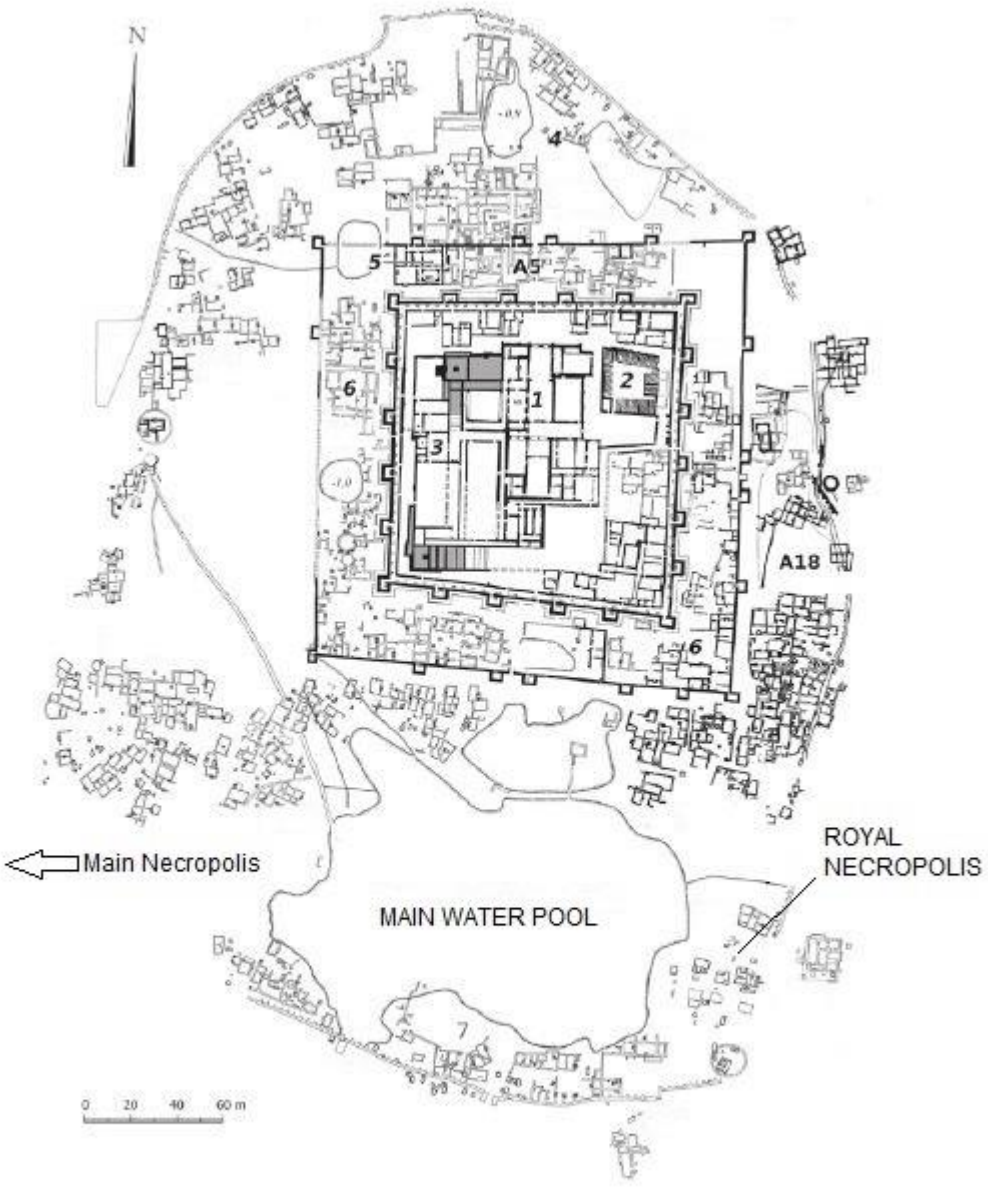


Figure 3.2 The image displays the multi-phase structure of Gonur North, featuring defensive walls and a central structure referred to as the palace. South of the main complex, there is the primary water pool, while the "Royal Necropolis" is located in the southeastern corner (adapted from Lyonnet and Dubova 2021a:Fig. 10.1A).

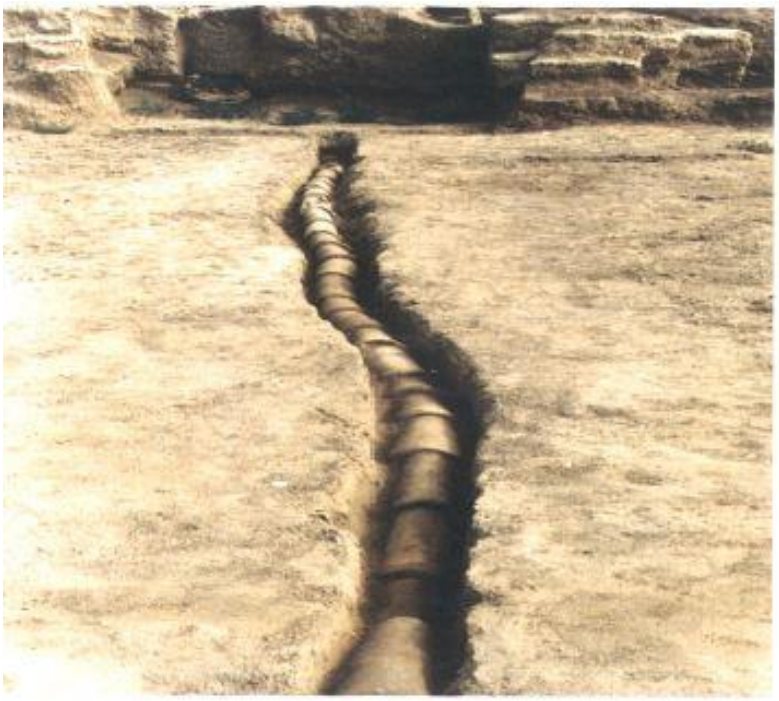


Figure 3.3 Water pipes found in front of the main entrance at Gonur palace (Rossi-Osmida 2002: 25).

Although the function of many rooms at Gonur North remains unclear, some were probably used to store materials, such as the parallel, narrow rooms in the northeastern part (Sarianidi 2005:83–87). Similar narrow structures have been identified at other fortified sites, such as Adji Kui 1 and Togolok 21, but also Dzharkutan and Sapallitepa in Uzbekistan, and some have brick-sealed entrances (Muradov 2021:151). Most likely, large sites, such as Gonur North, had granaries to store cereals, such as barley and wheat, cultivated in the nearby fields. These sites, might have had populations of more than 10,000 inhabitants (Markofsky 2010:280; also see chapter 7 for population estimation). However, populations were likely larger if one considers the presence of many satellite sites, like in the Gonur area.

- **Subsistence Economy**

In the absence of texts from the BMAC, its economy has been reconstructed from archaeological evidence. However, as has recently been pointed out by Lyonnet and Dubova (2021b:22), our knowledge about the BMAC economy is patchy, and the

stratigraphy from excavated sites is often problematic. Nevertheless, botanical and faunal remains provide evidence for subsistence economies (Hiebert 1994a:130–137; Sataev and Sataeva 2014; Billings et al. 2022).

The evidence from Gonur suggests that a good proportion of the domestic economy was devoted to livestock breeding. The most common animals kept were sheep and goats, followed by cattle. Sheep and goats included mature animals most likely kept for secondary products such as milk or wool (Moore et al. 1994). They were also likely kept for their meat. Wild animals, such as gazelle and wild pigs, have also been found and were likely part of the diet (also see section 2.4 in Chapter 2). However, they constitute a minor component of the faunal remains, comprising less than 5% at Gonur and 7% at Togolok 1 (Sataev 2021a; Cerasetti et al. 2022). Other animals, such as Bactrian camels, horses, and donkeys, were also found, with donkey bones more common than horses (Sataev and Sataeva 2014). These animals do not seem to be part of the diet in Gonur, in contrast to the ovicaprines, as well as cattle, which represent the majority of the meat consumed[20] (Sataev 2021a).

The diet was also comprised of domestic crops, which have been found in abundance. These include barley, wheat, and pulses. Six-row barley (*Hordeum vulgare* subsp. *hexastichum*) is the most common cereal found in the Murghab both in the Middle and Late Bronze Age (Miller 1993). However, the naked form predominates at Gonur (Miller 1999). Among the wheat species, free-threshing wheat (*Triticum aestivum*) is the most common. It has been suggested that the choice of barley can possibly be related to water susceptibility as barley is more drought-resistant than wheat. Naked barley requires more water than the hulled form, but the post-harvesting processing is easier (Spengler 2019a:116). As for wheat, Moore et al. (1994) mention the presence of dwarf or short wheat (*Triticum sphaerococcum*) from the upper levels at Gonur, which is considered a South Asian variety and is more drought-resistant (Costantini 1977). All in all, the

[20] In Togolok 1 ovicaprine remains from Late and Middle Bronze Age layers show evidence of butchery marks (N. Amano, Analysis of Faunal Remains from Togolok 1, Adji Kui 1, and Chopantam, Unpublished Report).

adoption of more drought-tolerant crops, such as barley, might be indicative of a less humid environment, possibly already towards the end of the 3rd millennium BCE.
Other cultigens that have been found are chickpea (*Cicer arietinum*), lentil (*Lens culinaris*), and pea (*Pisum* sp.) (Sataev and Sataeva 2014). In addition, evidence of grapes (*Vitis vinifera*) and possibly apples and plums were identified at Gonur, suggesting the presence of orchards in the area (Moore et al. 1994). The presence of these crops seems to be constant throughout the Middle and Late Bronze Age in the Murghab. By contrast, millet (*Panicum miliaceum*) is only attested so far in Late Bronze Age layers (see section 3.3 of this Chapter).

While a significant portion of the botanical and archaeozoological data from the BMAC originate from Gonur, which could potentially bias our understanding, evidence from Togolok 1 appears to show similar patterns (Billings et al. 2022; Cerasetti et al. 2022). As such, the data suggest that the subsistence economy of the larger sites was diverse. Besides meat, the economy was supported by the substantial consumption of cereals that dominated the botanical assemblages. Cereal cultivation (mainly wheat and barley) was accompanied by the presence of various legumes, including garden fruits, such as grapes. These were part of an integrated system in which cereal fields were combined with vegetable and garden areas, likely divided into zones. This suggests an agricultural system in which irrigation served to support different crops at various times of the year (Lamberg-Karlovsky 2013).

Most of the botanical data available in the Murghab, however, are from larger mounds. The survey data from the AMMD show the presence of several sites and hamlets across the landscape that might been involved in other types of crop cultivation (see section 3.4 of this Chapter for discussion). In fact, the data from the two excavated rural sites of Ojakly and Chopantam show less diverse botanical assemblages in comparison to larger sites such as Gonur. Moreover, these rural assemblages have a more common presence of millet which might indicate different agricultural practices. Nonetheless, most scholars have reconstructed agricultural practices during the Bronze Age as homogenous across the Murghab (Salvatori 2008a). The possible diversity of land exploitation is, therefore,

of crucial importance for understanding the BMAC. These aspects will be further discussed in Chapter 7.

- **Political System**

The political system of the BMAC has been the subject of various studies (Sarianidi 1990a; Hiebert 1994a; Lamberg-Karlovsky 2003; Salvatori et al. 2008). Interpretations of the Middle and the Late Bronze Age systems have mostly been based on settlement systems (Sarianidi 1990a; Salvatori and Tosi 2008). Likewise, a political system dominated by BMAC elites has been put forward on the basis of graves found at the Gonur North necropolis (Sarianidi 2010a). The richest burials take the form of chamber tombs[21] and cists (Dubova 2021) (which account for only 5% of the 2853 graves in total). The area where these burials were found is referred to as "royal necropolis" of Gonur North, separated from the main necropolis to the west of the settlement (Figure 3.2).

The "royal necropolis" includes several tombs with valuable grave goods. Of exceptional wealth is tomb 3220, which is an underground chamber with supporting walls and a roof (Sarianidi 2006:169). In this tomb, 24 metal vessels were found in gold (2), silver (17), and bronze (5) (Sarianidi 2008a:161; Sarianidi 2008b). In addition, a gold plate and a gold jug with a narrow neck (weighing 1 kg), together with agate beads, were also found, along with large silver vessels with two walking camels in relief (Sarianidi 2005). In some of the chamber tombs, a wooden container (not preserved) decorated with mosaic inlay was also found together with ivory objects (see Dubova 2021:table 10.1, for an exhaustive list).

Interestingly, a four-wheeled wagon was found in tomb 3200 next to the remains of a horse (Sataev 2021b:390). These rich graves, along with fortified citadel within the sites resembling a palace, have been interpreted as evidence of a stratified society with elites[22] (Sarianidi 1990a; Hiebert 1994a; Salvatori et al. 2008; Lamberg-Karlovsky 2003;

[21] The chamber tombs are sometimes reported as hypogea in the "royal necropolis" (Dubova 2021).
[22] In contrast to Sarianidi's interpretation, the area of the "royal necropolis" has been interpreted by Lamberg-Karlovsky (2013), as houses with burials underneath the floor.

Francfort 2009). According to Vidale (2017:23–25) the stories of the BMAC elites and their lifestyles are also represented on the BMAC silver objects.

These elites were possibly supported by an embryonic administrative structure. The presence of sealed bullae, geometric tokens, and BMAC-type compartmented stamp seals all suggest the presence of an (early) administrative system, although evidence of an administrative use of these objects has only been documented at Taip 1 and Gonur North (Sarianidi 1998a:23; Sarianidi 1998b; Masimov and Salvatori 2008:106–107).

According to Lamberg-Karlovsky (1994a) the presence of fortified buildings with towers and double walls, such as those at Kelleli 3 or Gonur North, may be compared to later 19th-century *khanates* of Central Asia. The Khanates are understood as an administrative polity ruling over a circumscribed territory from a fortified center that was also the residence of a local *Khan* (Lamberg-Karlovsky 2013). One example of these residences may be Adji Kui 9. The site is located northwest of Gonur and is a typical BMAC doubly fortified settlement with an inner fort. East of Adji Kui 9, at a short distance, the site of Adji Kui 1 was a similar fortified settlement with towers but with individual houses only, with a separated "farmstead" to the south of the site (Figure 3.4). Adji Kui 9 is interpreted by Rossi-Osmida (2007:119) as a possible residence of elites (Lamberg-Karlovsky 2013). Within a system characterized by fortified settlements and elites, the control over the water resources and agricultural areas might have involved tribal rules, according to Lamberg-Karlovsky (2016:42). However, archaeological evidence to support this idea is limited. Crucial aspects of the possible complexities of land exploitation, agricultural production, and water management, and their relationship with the socio-political system remain largely unexplored.

The presence of a "royal necropolis" with rich burials at Gonur North, and its fortification system, which is the largest in the Bronze Age Murghab, could suggest that Gonur possibly played an important political and economic role in the Middle Bronze Age (but see section 3.4 of this Chapter for discussion). Nevertheless, how this translates into control over the landscape and water is unclear. Certainly, the Middle Bronze Age

system went through a radical change at the beginning of the 2nd millennium BCE. Both in the Murghab, as well as in the Kopet-Dag, many settlements were abandoned, and there was a visible contraction of settlement clusters (Kohl 1984:135–138; Salvatori 2008a).

This settlement transformation has been interpreted as a "political crisis" that eventually resulted in a de-centralized system in which Gonur was no longer the main site (see the section below and section 3.4 for discussion) (Salvatori 2008a:66; Cerasetti and Luneau, forthcoming). However, Lamberg-Karlovsky (2013:58) is right in asking whether BMAC communities ever had a unified polity or consisted of a series of regional political entities both in the Middle and Late Bronze Age. The investigation of how the local landscape, water, and the agricultural system were managed can contribute to this broader discussion and will be continued in Chapter 7.

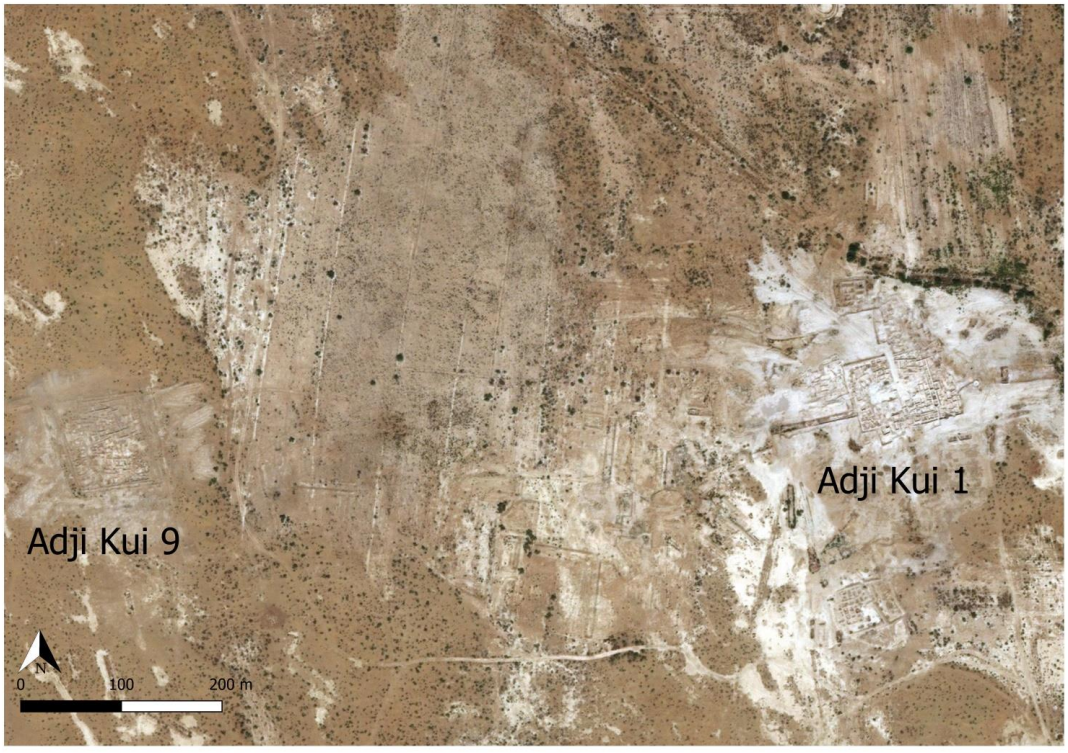


Figure 3.4 The satellite image (Landsat 8, 2019) depicts the sites of Adji Kui 1 (on the right) and Adji Kui 9 (on the left), situated relatively close to each other. Adji Kui 9 features a fortified fortress. Between the two sites lies a necropolis that was shared by both settlements.

- **Ceramic Assemblages**

In this study, it is important to highlight that pottery chronology remains challenging in the Murghab. Udeumuradov (1993) and P'yankova (1993) offer insightful analyses of Murghab ceramics; however, the Namazga pottery chronology often remains inadequate and lacks regional divisions. Particularly valuable is the pottery analysis conducted by Hiebert (1994a:39–73) at Gonur North, which provides a useful chronological sequence divided into local periods (periods 1, 2, and 3). However, Hiebert's chronological sequence was published in 1994 and since then only new few publications have appeared (but see Udeumuradov 2002; Luneau 2010). The later AMMD publications (Gubaev at al. 1998; Salvatori et al. 2008) provided additional information on the pottery sequence both for the Bronze Age and later periods with useful tables from other excavations, including ICW (Andronovo) pottery (Cerasetti 1998). In the AMMD publications, the late phase of the Bronze Age is divided into the Late and Final Bronze Age (1950–1500 and 1500–1300 BCE). This division is mainly based on the analysis of materials from the Takhirbaj 3 site (i.e., Takhirbaj 3 phase) which is dated to the last phase of the Bronze Age (Cattani and Salvatori 2008). In this study this chronological division between the Late and Final Bronze Age is taken into account.

On the basis of Hiebert's study of Gonur North, during the Middle Bronze Age pottery can be divided into two main periods (Period 1 and 2) characterized by different pottery typologies. These typologies can be divided into four main categories (see Figure 3.5 for the pottery typology of Period 1 and 2). The small vessels are primarily identified by having rim diameters smaller than 15 cm, encompassing items such as bottles, miniature vessels, and small bowls or cups. Large thin vessels, with a general diameter between 15 and 45 cm, represent the main category. This category includes several types, such as thin-shouldered vessels with an upper sherd body thickness ranging from 0.35 to 0.65 cm (Hiebert 1994a:46). Within the additional category of large thick-walled vessels, there are two distinct forms: closed forms primarily intended as storage vessels, and open forms, which may sometimes feature decorations and are less likely to be used for storage purposes. The last main category comprises large storage vessels with very thick walls.

Among this category, the major forms are wheel-made jars with a large base, generally over 70 cm. It is also interesting to note that some of these forms can be taller than 1 m (Hiebert 1994a:56).

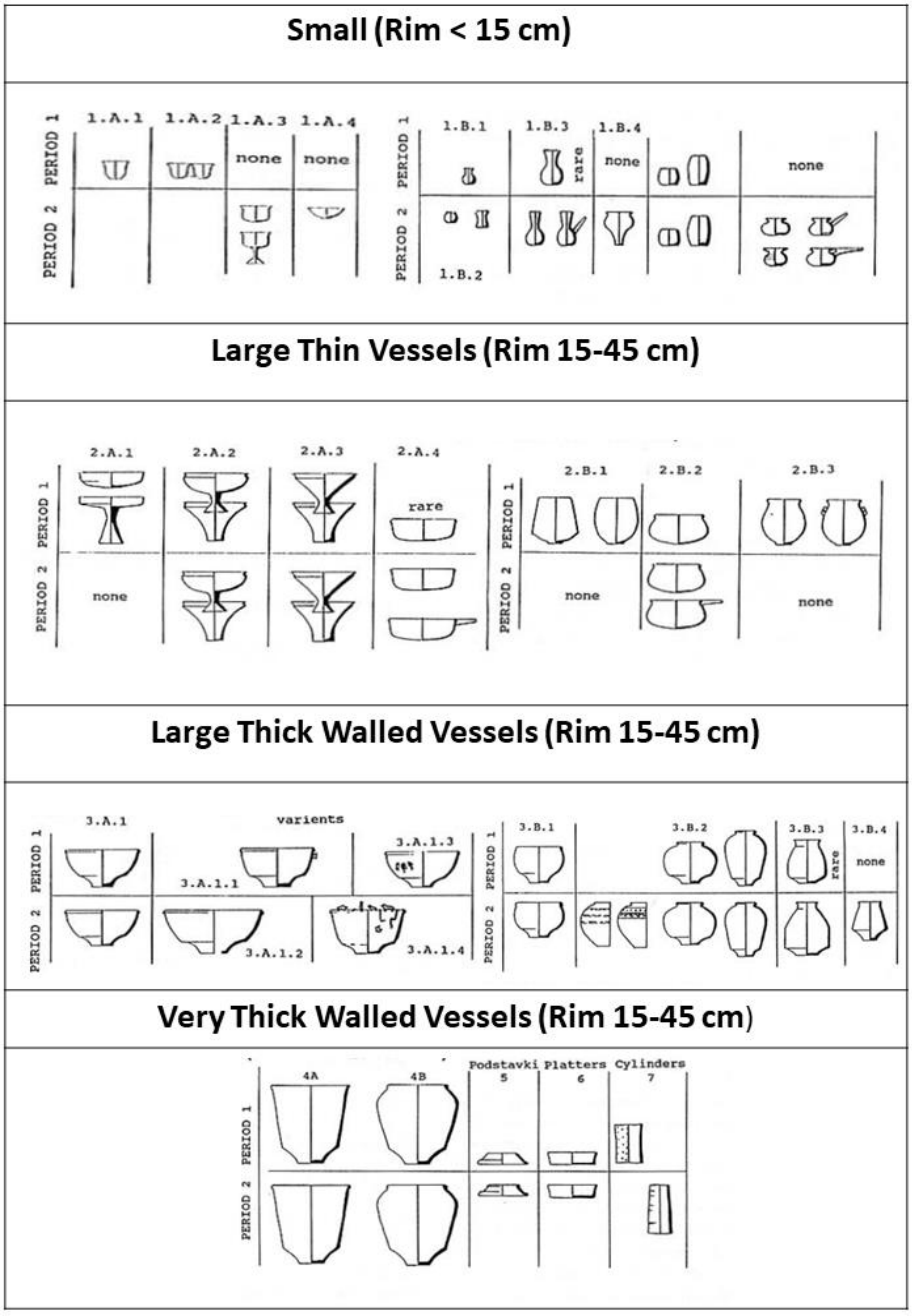


Figure 3.5 The ceramic typology of Periods 1 and 2, as analyzed by Hiebert from the deep sounding at Gonur North (adapted from Hiebert 1994a:Fig. 4.35).

Both Periods 1 and 2[23] are characterized by a medium-fine paste with chaff temper. While in Period 2 there is well-sorted fine quartz temper, in Period 1 there is no sand in the temper. The wheel-made pottery ranges from light red to reddish buff (Hiebert 1994a:41). However, Period 1 ceramics seem less red than those of Period 2, while in a domestic context, many pottery pieces have a greenish exterior due to over firing. According to Hiebert (1994a:67) these greenish ceramics have been found in great numbers and were used regardless of having been misfired.

The majority of the ceramics from both periods are undecorated. However, among the decorated ones in Period 1, the most frequent design is horizontal bands around the shoulder and body, while Period 2 vessels that present decoration are generally characterized by reddish-brown paint only. In addition to decoration, potter's marks are also found in Period 2, although they are not very common. Most of these marks have geometric figures and are found on the side or lower shoulder, base, or bottom part, but also inside the vessels. Likewise, seal impressions – made on vessels prior to firing – with several motifs have been found in a small percentage, although their function is not clear (Hiebert 1994a:59–61).

Of particular interest among the large vessels with thick shoulders are the basins with terracotta rim decoration. These vessels, characterized by a series of small figures, animals and humans on the rims, have been found at different sites in Margiana and Bactria, and in Gonur occur in Period 2. According to Hiebert (1994a:53) the figures on the rims have a particular order, suggesting a possible narrative (Figure 3.6). In addition, according to Sarianidi (1990a), these particular vessels were used during rituals and ceremonies, such as libations.

[23] Unfortunately, there are no ^{14}C dates for this two periods and division of these periods based on dates are not provided in Hiebert's publication.

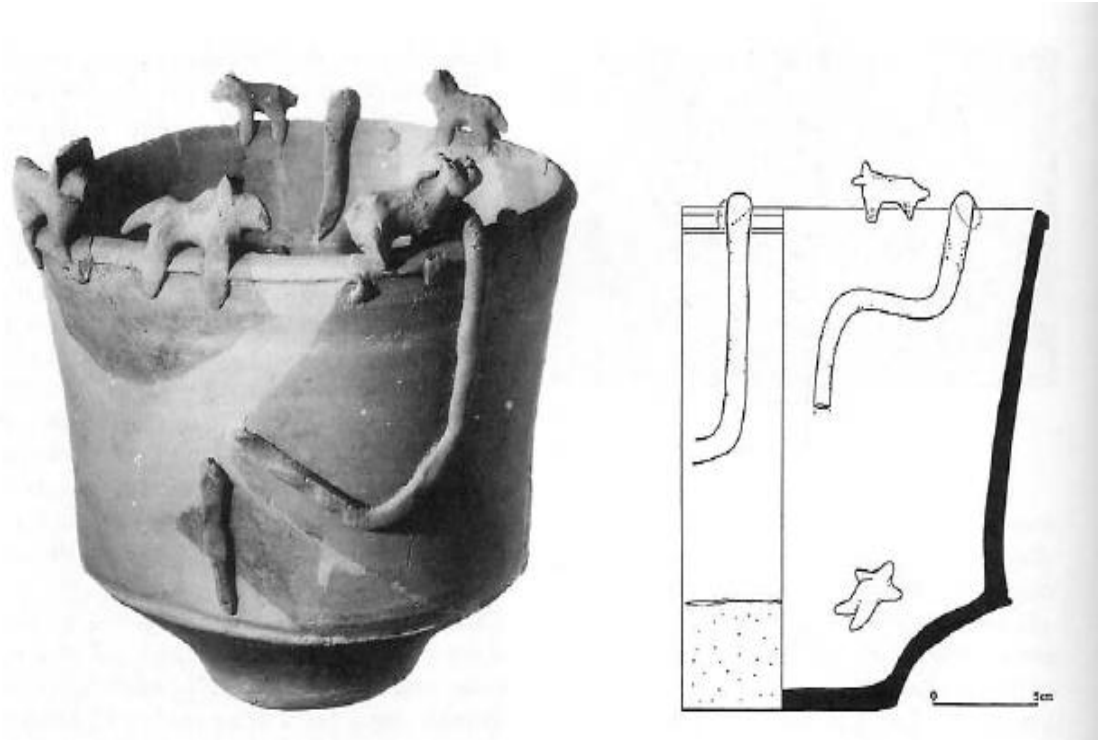


Figure 3.6 The figure shows a Period 2 vessel with terracotta figurines applied from Togolok 1 (Hiebert 1994:Fig. 4.20).

3.2.1.2 The Late and Final Bronze Age and the "Collapse" of the BMAC

The Late and Final Bronze Age (1950–1500 and1500–1300 BCE) show a considerable decrease in the size of the major settlements and their architecture, as well as an important change in settlement patterns in the Murghab, including the appearance of small settlements (see section 3.4 of this Chapter for discussion on settlement patterns). However, this change does not oppose a shift in the BMAC subsistence economy. Botanical data shows the same cultivated crops as for the previous period, such as barley, wheat, pulses, and garden fruits. Likewise, the recent archaeobotanical analysis from layers radiocarbon dated to the Late Bronze Age from Togolok 1 suggests continuity in crop production (Cerasetti et al. 2019). However, differences in agricultural exploitation

existed between dense settlement clusters and rural areas, as I will argue later. In addition, starting from the early 2nd millennium BCE, there is decisive presence of broomcorn millet (Miller at al. 2016:1571). Millet, which is a more drought-tolerant crop than barley and wheat, was recovered from rural areas such as Ojakly and Chopantam, and from impressions on a vessel from the fortified sites of Gonur North and Togolok 21 (Bakels 2003). More recently, evidence of millet has also been found at Togolok 1 from Late Bronze Age layers (Billings et al. 2022). Interestingly, millet is also common at the site of Shortughai in Bactria during this period (Willcox 1989:175–183).

Similar to crop farming, animal husbandry – mainly sheep and goat – did not undergo much change during this period (Salvatori 2008a). It appears that the subsistence economy did not experience radical changes. However, as this thesis will argue, although agricultural management of water resources underwent radical change (see Chapters 5 and 6).

The Late Bronze Age is characterized by the presence of round towers along fortified buildings, such as at Togolok 21. The general architecture plan with very thick exterior walls, such as in Gonur South, and a fortified building at the center is maintained during this period in the Murghab, but we see a marked reduction in the size of large, fortified settlements. This transformation was characteristic not only for the Murghab but also for the Kopet-Dag (refer to section 3.4) (Hiebert 1994a:114–155).

Between ca. 1750 and 1400 BCE, there is also a significant change in the material culture of the BMAC. Prestige goods such as metal ornaments, but also precious and semi-precious stones, became rare, as well as weapons. The terracotta violin-shaped figurines, characteristic of the Middle Bronze Age (Salvatori 2002:107–113; Forni 2017), disappear during this period (Masimov et al. 1998:34). Conversely, there is the appearance of miniature metal objects in graves, such as metal disks or weapons (Luneau 2021a:501, Fig. 18:3). Luneau (2021a) argued that it is a *qualitative* decrease in the objects and imagery that reflects a change in BMAC society. Objects in burials are fewer and of lesser quality compared to those of the Middle Bronze Age (Luneau 2021a: 505). In

southern Uzbekistan and Tajikistan, the amount of tombs without bodies seems to increase (Bendezu-Sarmiento and Lhuillier 2019; Dubova 2021). During the Late phase of the Bronze Age, there is also a change in the ceramics. These are now red-burnished wares, with a red slip and sometimes incised decoration (Hiebert 1994a:71; P'yankova 1993). Red-burnished wares are typical of the Namazga VI period. The goblets from this period have a distinctive ridge below the rim, while an inturned rim is observed in the large vessels with the appearance of distinctive cups as well (Hiebert 1994a: 71, Fig. 4.40) (Figure 3.7). Like in the previous Middle Bronze Age, wheel-made ceramics predominate over hand-made pottery. However, Luneau (2021a:501) argues that this distinction in percentage between hand and wheel-made pottery might need to be reevaluated in light of recent excavations; for example, at the site of Saredjar 2 in Tajikistan, most of the assemblage (85%) is hand-made pottery. According to Luneau (2021a), during this period, there is a strong regionalization of pottery. However, the ceramic assemblages and chronologies of the BMAC remains poorly documented. This is also reflected in the lack of further regional subdivisions.

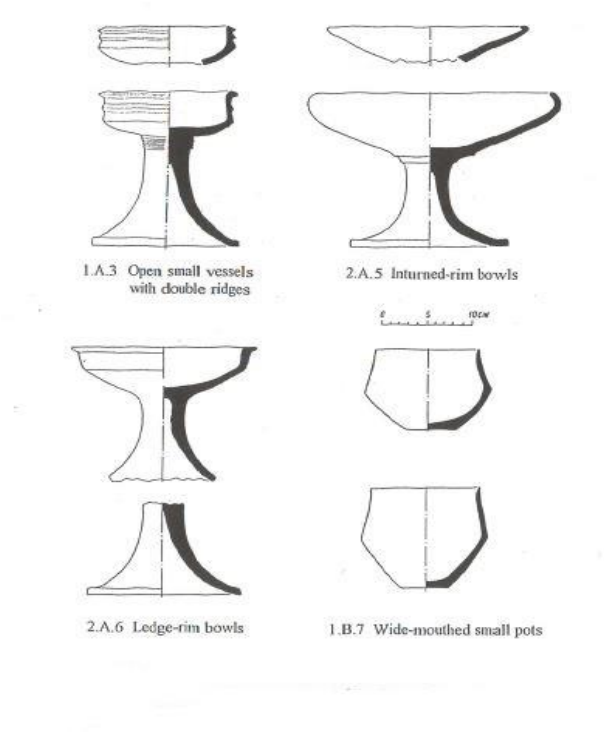


Figure 3.7 Ceramic forms from Takhirbaj 3 (Hiebert 1994:Fig. 4.40).

One significant change from the Late Bronze Age in the Murghab is the presence of the "Andronovo" (ICW) ceramic assemblages, which are different from Namazga pottery. These assemblages are further discussed in section below; however, what is important here is that the presence of these assemblages is indicative of a possible intensification in cultural and economic contact with the northern regions, not attested during the preceding period (Kuz'mina and Lyapin 1984).

The architectural shifts, reduction in the size of large, fortified sites, and the notable decline in luxury goods during the Late phase of the Bronze Age have frequently been interpreted by scholars as being indicative of a "collapse" in the economic, social, and political system of the BMAC. However, as argued by Luneau (2019; 2021a), this so-called collapse should be best viewed as a long "transformation" of BMAC society, rather than a social collapse. Certainly, the reduction in luxury goods mark a discontinuity in the local "elites" and suggest a reduction in trade (Cerasetti and Luneau, forthcoming).

While a thorough examination of the origin and evolution of the end of the BMAC lies beyond the scope of this dissertation, it is important to acknowledge that the reasons for these changes are likely complex and diverse. Of particular relevance for the present research is the transformations that took place in its hydrological landscape and their implications for crop cultivation and irrigation practices.

3.3 The "Andronovo" Presence in the Murghab Region

These "Andronovo" or Incised Coarse Ware (ICW) assemblages in the Murghab are mainly attested from the Late Bronze Age. These assemblages with affinities to "Andronovo" materials from the northern regions has been linked by various scholars to Andronovo communities, often associated with pastoral groups in Central Asia[24] (Hiebert 1994a; Cattani 2008b; Rouse and Cerasetti 2014). The term "Andronovo" broadly encompasses a diverse range of steppe communities stretching from western Mongolia

[24] However, Andronovo sites in Uzbekistan, for instance, are not always linked with pastoral activities.

and the Urals to southern Margiana and northern Afghanistan, including Tajikistan, Uzbekistan. While each group has its own unique characteristics, they share commonalities in funerary practices, material culture, and subsistence economy (Bonora 2021). These Andronovo (ICW) ceramics predominate at rural and ephemeral sites in the Murghab. This evidence has been interpreted as indications of pastoral groups interacting with large BMAC sites (Cattani 2008b; Hiebert and Moore 2004).

The presence of these Andronovo (ICW) assemblages has also been linked with the "collapse" of the BMAC discussed above (Kuz'mina and Lyapin 1984; Vinogradova and Kuz'mina 1996). However, no traces of destruction, intentional burning, or conflicts have been observed in the archaeological record of the Murghab sites, nor in the Kopet-Dag region, where sites also show Andronovo (ICW) assemblages (Biscione 1977). By contrast, these assemblages have been interpreted as evidence for peaceful interaction between BMAC agriculturalists and Andronovo groups in the region (P'yankova 1993; Masson 2002; Salvatori and Tosi 2008).

Further interpretations of the Andronovo (ICW) pottery in the Murghab focus on trading contact. These ceramic assemblages have been interpreted as an intensification of trade with north and northeastern regions during the 2nd millennium BCE (Lyonnet and Dubova 2021a; Luneau 2021b). In neighboring regions, such as the Zeravshan Valley in Uzbekistan, archaeological evidence suggests that several Andronovo sites were directly involved with the exploitation of metal-bearing deposits (Avanesova 2021:667). These sites do not present characteristics of mobile or semi-mobile settlements, but are nevertheless characterized by Andronovo material culture. The region of these sites contains significant ores and minerals, including copper, silver, gold, lead, and especially tin. Metallurgical activities by Andronovo groups are well attested through site excavations (Kuz'mina 1991; 1994:137–146; 2007:85–99; Boroffka et al. 2002; Garner 2021:799). Recent analyses of metal objects from the BMAC found that during the BMAC "mature period" (ca. 2250–1700) copper arsenic alloys were most common. In the Late Bronze Age, however, this was substituted by tin bronzes with a low arsenic content and unalloyed copper (Kraus 2021). According to Lyonnet (2005) this change in

the composition of metal objects is indicative of a change in metallurgical production that might link up with a possible intensification of contact with Andronovo groups involved in metal production in the neighboring region. However, in the Murghab, only a few sites associated with Andronovo (ICW) assemblages have been excavated, and none of these show evidence for metallurgical activities or ingot trade. Nevertheless, data from the Central and West Asia region suggest that long-distance metal trade did occur, as the recent analysis on Uluburun shipwreck tin suggests (Powel et al. 2022).

Although Andronovo (ICW) pottery in the Murghab is now well attested, these assemblages were initially considered marginal by Soviet scholars who found little of this material in fortified sites. They initially labeled these ceramics as "steppe" material (Kuz'mina and Lyapin 1984; Sarianidi 1975; 1990a). However, the surveys carried out by the AMMD between the 1990s and 2000s revealed a substantial occurrence with 74 sites characterized by "Incised Coarse Ware" (ICW) ceramics.[25] This pottery is characterized by hand-made grog-tempered pottery often with incised decoration (Figure 3.8).

Figure 3.8 Typical hand-made "Andronovo" (ICW) pottery from the Chopantam site (previously called site 1211/1219) with fragments of wheel-made pottery (Cattani 2008a:Fig. 9.6).

[25] There are 175 sites that present both Namazga and Andronovo (ICW) ceramics.

It has been argued that this hand-made and incised pottery is similar to the Tazabag'yab (Andronovo) groups in the southern delta of the Akchadar'ya in Khoresmia (Cattani 2008b). Recent XRD/XRF and petrographic analyses conducted on both wheel-made BMAC pottery and hand-made Andronovo (ICW) pottery from Ojakly suggest, however, that these two assemblages were produced from the same clay source (Rouse et al. 2019). As such, Andronovo (ICW) pottery in the Murghab was likely locally made rather than imported from Andronovo regions. However, current archaeological data from the Murghab do not provide evidence for any large pottery production areas, but rather possible small household pottery production, such as at the Ojakly site (Rouse and Cerasetti 2014).

Although the presence of two distinct assemblages in the Murghab from the Late Bronze Age is clear, many research questions remain about the people who used and made these assemblages and to what extent they were distinct groups. Likewise, we need to question the direct relation postulated between Andronovo (ICW) pottery and a specific type of subsistence economy (i.e., pastoralism for Andronovo (ICW) pottery sites and agriculture for BMAC pottery sites) (Hiebert 1994a; Kuz'mina 2007; Salvatori et al. 2008; Lamberg-Karlovsky 2013; Lyonnet and Dubova 2021a; Luneau 2021a). Nevertheless, the presence of these assemblages in the Murghab is of key importance, and the few rural "Andronovo" (ICW) sites excavated in the region deserve a short discussion.

3.3.1 Excavated Rural Sites in the Murghab

As briefly discussed in section 3.2, most of the archaeological research conducted in the Murghab has concentrated on larger sites, while excavation of rural, as well as small Andronovo (ICW) sites, has been less central. Yet, archaeological evidence from the last two decades suggests that Andronovo (ICW) sites cannot be regarded as marginal, as almost 74 sites with these assemblages have been recorded by the AMMD. While the discussion on the rural Andronovo (ICW) site of Ojakly will occur in Chapter 5, here I will briefly discuss data from two more excavated rural sites in the Murghab.

- **Gonur-N.**

The site of Gonur-N is located approximately 1 km southwest of the large site of Gonur South in a dune area. The site is dated to ca. 1800–1500 BCE and was characterized on the surface by a predominance of hand-made incised pottery (85% out of 150 sherds collected) (Hiebert and Moore 2004). The rest of the pottery (15%) consisted of wheel-made BMAC-Namazga pottery. The excavation of a test trench of 1 m by 1 m revealed a 90 cm deposit of fine sand overlying layers with in-situ incised hand-made pottery with a few wheel-made BMAC ceramics that matched the pottery found on the surface. The excavation did not show any evidence of possible permanent occupation, such as mudbricks or floors, either on the surface or in the test trench. However, this may also be related to the relatively small size of the excavated trench.

The wheel-made ceramics found at the site are characterized by large tableware shapes, including plates, cups, and tall-footed goblets. According to Hiebert and Moore (2004), the evidence suggests that Gonur North was possibly a seasonally occupied site with no evidence for agriculture. As such, the excavators argued that the Gonur N community was solely engaged in pastoral activities and possibly exchanging products with the nearby site of Gonur.

Interestingly, the site of Gonur-N is situated close to a low ridge interpreted as a paleochannel. The site is located less than 250 m from the current watercourse in an area with a large ceramic scatter (Figure 3.9) (Hiebert and Moore 2004:Fig. 1). According to Wilkinson (2014), these ceramic scatters in the Murghab might be associated with manuring practices. In that case, the site would have been located close to agricultural fields suggesting a possible involvement in agriculture.

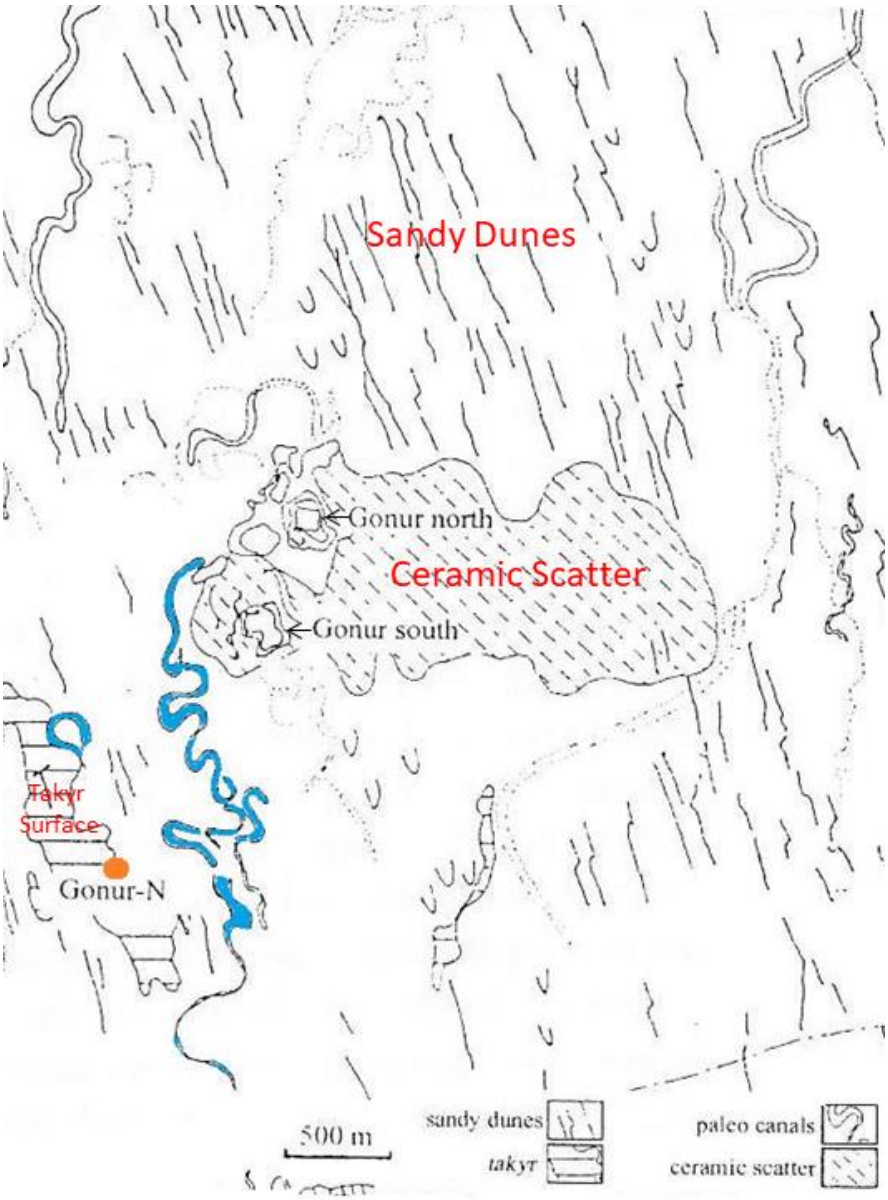


Figure 3.9 The map shows the location of Gonur N (in orange) and its relationship with agricultural fields and paleochannels (in blue) (adapted from Hiebert and Moore 2004:Fig. 1).

- **Chopantam**

The site of Chopantam (also published as site 1211/1219) is the southernmost rural site excavated in the Murghab and is located 10 km southeast of the large site complex of Takhirbaj. Unlike the site of Gonur-N, Chopantam is not located in close proximity to any large, fortified centers. The site has various occupation phases and has both

Andronovo (ICW) ceramics and wheel-made Namazga pottery. However, Andronovo (ICW) sites are predominantly characterized by ICW ceramics.. The radiocarbon analyses from Chopantam date the site to ca. 1550–1300 BCE (Cattani 2008a).

In trench 2, the excavators found a sunken dwelling unit at approximately 50 cm depth with vertical walls and an entrance formed by a step (Cattani 2008a:129). Several post-holes were also found, which were probably supporting a roof structure with posts. The dwelling has a circular hearth and a sequence of two ovens.

Findings from Chopantam comprise a grinding stone and several vessels. Three of these vessels contained remnants of charred cereals (*Triticum and Hordeum*) and were found in a pit which was probably there to store them. As such, the area has been interpreted as a cereal storage and processing area that was exposed to fire before it was abandoned. Additional archaeobotanical analysis at Chopantam also showed the presence of other cereals (*Hordeum vulgare, Triticum aestivum/turgidum*), as well as millet (*Panicum miliaceum*) and domestic pulses (*Pisum sativum*, *Lathyrus sativus*, and *Lens culinaris*) (Spengler et al. 2014:Table 2).

At the southern limit of the site, the excavators found an ancient water channel that was not visible on the surface (Cattani 2008b:125). The inactivity of the channel appears to have occurred before or during the life of the site. The presence of pottery and charcoal in the channel has been interpreted by the excavators as an indication of an anthropogenic origin of the watercourse (Ninfo 2007). The stratigraphic sequence of the channel includes a stage of reactivation after a dry period, which might suggest human management of the channel. However, this evidence does not explicitly point to an anthropogenic origin of the channel, as natural channels can also be managed (see Jotheri 2018 for more discussion).

The presence in Chopantam of domestic crops, storage areas, and food processing tools suggest that the inhabitants were involved in farming activities. As such, the people that were living at Chopantam can be best interpreted as “agropastoralists” with strong

pastoral component. Likewise, the stratigraphic analysis of the channel, suggesting possible management (Ninfo 2007) and its proximity to the site, may suggest that inhabitants of Chopantam used its water for agricultural activities. However, the presence of a semi-subterranean dwelling and post-holes, as well as the predominant presence of Andronovo (ICW) pottery, has been linked to pastoralism by the excavators (Cattani 2008b).

In conclusion, the evidence from Chopantam suggests that both crop cultivation and pastoral activities were likely practiced at the site. The significant presence of millet may indicate low-investment agriculture within an environment marked by heightened aridification by the latter half of the 2nd millennium BCE (Cremaschi 1998).

3.3.2 Urban–Pastoral Interaction and Local Models of Variability

The question of the interaction between the groups associated with sites that show a predominance of Andronovo (ICW) pottery assemblages and sites with BMAC assemblages (Namazga pottery) has been discussed by various scholars (Sarianidi 1990a; Vinogradova and Kuz'mina 1996; Cattani 2008b; Cerasetti 2012; Rouse 2020; Doumani Dupuy et al. 2021). However, the nature of this interaction is still unclear (Cerasetti 2021).

On the basis of the survey and excavations conducted in the region, it appears that, starting from the Late Bronze Age, the Murghab was characterized by the coexistence of two distinct pottery assemblages: the Namazga hand and wheel-made pottery and the incised hand-made "ICW" or "Andronovo" pottery. Andronovo (ICW) ceramics are present at many sites in the Murghab and their occurrence outside of their primary geographical distribution has been interpreted by various scholars as evidence for "steppe-related" pastoralist groups in the Murghab. While this hypothesis is plausible, it oversimplifies the association between ceramic assemblages and human populations. Based on this hypothesis, Andronovo (ICW) sites have typically been linked with pastoralist groups settled near pre-existing concentrated settlements (Sarianidi 1975;

Kramer 1977; Vinogradova and Kuz'mina 1996; P'yankova 1989; 1993; Hiebert 1994a:69; Cattani 2008b). Their location also suggests that interaction with dense settlement areas was common. Nevertheless, the distinction between the two pottery assemblages and the communities using them has been interpreted as representing clear boundaries between lifestyles and economies in the Murghab (Doumani Dupuy et al. 2021). From one side BMAC sites are mainly devoted to agriculture, and on the other Andronovo (ICW) sites are mainly engaged in pastoral activities (Salvatori at al. 2008). However, botanical remains show that rural sites with Andronovo (ICW) pottery were also engaged in different forms of crop cultivation, and their subsistence economy cannot be ascribed as fully pastoral on the basis of pottery assemblages alone. The subsistence economy was influenced by local resources, such as water availability, both for BMAC and Andronovo (ICW) pottery sites in the Murghab as I will argue later in this thesis. As such, diverse agricultural and water exploitation strategies by local communities (both Namazga and Andronovo (ICW) pottery sites) were probably in place in the Murghab and will be discussed in Chapter 7.

Recently, in parallel to Petrie's (2019) paradigm of the Indus Civilization being a cultural "veneer" of urban centers, Rouse (2020) has argued that a similar Oxus veneer existed and probably intensified in a de-urbanized context of the Late Bronze Age (also Luneau 2021a). Similar conclusions about different agricultural strategies have also been recently proposed for the Indus Civilization (Bates and Choi 2023). In this context, delving into the examination of local sites within their broader landscape context becomes imperative in order to unravel the genuine difference in agricultural and water management strategies. Such an approach allows for a more comprehensive understanding of how various factors such as hydrology and land use practices interact to shape agricultural systems and water management techniques within a given region. By considering the wider landscape context, we can discern the nuances in agricultural practices and water resource utilization across different sites, contributing to a more nuanced and accurate interpretation of past human–environment interactions.

3.3.3 Millet Cultivation and Agricultural Variability

The spread of millet (*Panicum miliaceum*) cultivation across Central Asia seems to have occurred in the second half of the 1st millennium BCE (Frachetti 2012; Miller et al. 2016). However, Spengler and Willcox (2013) suggested that broomcorn millet may have been introduced into the region at the end of the 3rd to early-2nd millennium BCE, and the Murghab has some of the earliest evidence for millet at the sites of Ojakly, Chopantam, and Adji Kui 1 (Spengler et al. 2014; 2018). Possible evidence of millet is also attested from vessel impressions from Gonur North and Togolok 21, while more recently carbonized millet seeds have been discovered in Togolok 1 as well (Billings et al. 2022; Bakels 2003; contra Meyer-Melikyan and Avetov 1998).

Millet in the Murghab is mostly attested at rural sites and has been suggested that contact with northern steppe groups was possibly instrumental in the introduction of this crop in the region (Spengler et al. 2014). The use of millet for a low-investment agriculture has often been associated with mobile groups in Eurasia (Pashkevich 2003). Perhaps millet was used for opportunistic farming at seasonally occupied sites. In this context, millet requires less labor and land investment and has comparable yields to barley and wheat, a short growing season and, generally, less water demand. The aridification process that seems to have characterized the Murghab in the 2nd millennium BCE, and possibly earlier, may be consistent with the introduction of a more drought-tolerant crop like millet (Spengler et al. 2014). Likewise, the cultivation of this crop could have also been used to mitigate famine risks. However, the differences in crop cultivation between dense settlement clusters and rural areas might be linked to patterns of land exploitation in which large sites, possibly equipped with canals, did not require the cultivation of more drought-tolerant crops. In this context, analysis of land use practices is desired to better understand such differences. This is the aim of the two case studies presented in Chapters 5 and 6.

3.3.4 A Comment on the Terminology

The Andronovo (ICW) pottery sites in the Murghab have often been defined as "pastoralists" (Hiebert 1994a; Vinogradova and Kuz'mina 1996; Cattani 2008b). However, evidence from these sites, as discussed above, suggests diverse subsistence strategies. Recently, Rouse and Cerasetti (2018) have classified these sites as belonging to "agropastoralists." Wendrich and Barnard (2008:5) outlined three types of broad mobility (see below). Nevertheless, it's crucial to acknowledge that these classifications generally oversimplify different forms of subsistence economies. Indeed, Bernbeck (2008) is right to suggest that various types of mobility can coexist simultaneously within the same communities.

The first broad category of Wendrich and Barnard (2008) is *pastoral nomadism* which is a broad term that defines mobility centered on the maintenance of flocks (mainly sheep and goats) that are taken from one place to another. Groups move across the landscape to meet human and animal needs. They might occupy the same places several times a year, depending on the routes but they rarely occupy one single place for long time (i.e., seasonal movement).

The second broad category is *semi-mobile pastoralism* that can be defined as a group of people in which the group seasonally occupies specific places. In this case they move two or three times a year. This is the case for examples of modern semi-mobile Kyrgyz pastoralist in the Wakhan-Pamir corridor (Afghanistan) that move two times in a year between summer and winter camps (Callahan 2013:82).

A third broad category is *agropastoralism*, which can be categorized as a combination of pastoral and crop cultivation activities, often viewed as low-investment agriculture (Wendrich and Barnard 2008:7; Buccellati 2008:142).

In the Murghab, archaeological investigations have concentrated on large, fortified sites, and it is likely that the small sites differed in their mobility and agriculture compared to main settlements. Evidence from rural sites suggests forms of agropastoralism, possibly

linked to seasonal movement. These sites show evidence of livestock breeding alongside evidence of crop cultivation. For example, both the Chopantam and Ojakly sites (refer to Chapter 5) reveal traces of less permanent structures like post-holes supporting lightweight constructions, along with botanical remains. Further, the site of Chopantam also exhibits evidence of tools for cereal processing. Altogether, this may suggest a seasonal occupation at these sites, possibly associated with low-investment crop cultivation within an agropastoral economy. In contrast, other sites in the Murghab, such as Gonur N., can probably be best interpreted as a small mobile pastoral camp and has not yielded any botanical remains or evidence of permanent structures (Hiebert and Moore 2004).

Therefore, categorizing these small sites across the Murghab simply as "mobile pastoralist" sites, as has often been done in previous decades based on pottery assemblages, is overly simplistic (Cattani 2008b). In this dissertation, I will instead refer to these sites with broad term of "rural sites."[26] I will also employ more specific terms, such as "agropastoralist site" or "mobile site," when these terms, as defined by Wendrich and Barnard (2008), align with the context and characteristics discussed above.

For site clusters with fortified citadels, I will use the broad terms of "dense settlement clusters" or "settlement concentrations." These areas have been considered as oases by Sarianidi (1990). However, while a reconsideration of the oases aspect will be discussed in the last chapter, the use of this term would be misleading in the light of more complex land exploitation by the 2nd millennium BCE. Likewise, it is equally crucial to note that sites like Gonur North, spanning 50 ha and featuring three round walls, can also be classified as an urban area (see Figure 3.2). However, most sites in the Murghab exhibit less complex structures, making the term "urban" inadequate, as exemplified by Kelleli 3, which comprises a small fortified citadel with a simpler internal layout compared to Gonur North. Therefore, while acknowledging the complexity of terminology and the distinctions among urban, proto-urban, and non-urban sites, in this thesis I will

[26] In this context, the term "rural" refers to any site that is part of the main fortified centers such as Gonur or Toglok 21. This broader terminology encompasses a variety of sites, which can differ in size and functionality.

collectively refer to these areas as settlement clusters or settlement concentrations, irrespective of their size and potential population.

3.4 Models of BMAC Landscape Development

3.4.1 The Early Soviet and AMMD Models

The prevalent interpretation and concept of "oases" in the Murghab derives from the excavations and surveys in the 1950s and 1960s (Masson and Sarianidi 1972:137). Soviet scholars saw the Murghab alluvial fan as composed of a series of clustered sites grouped in oases interspersed over the desert. This model was also supported by early paleoclimatic interpretations of the landscape (but see Chapter 2). Both Lisitsina (1978) and Gerasimov (1978), for instance, considered the region primarily as a desert environment over the last ten thousand years. Similarly, Dolukhanov (1981) argued for an almost arid environment. The Murghab was thus interpreted as an arid landscape with an active alluvial fan. In this landscape, areas such as Kelleli, Gonur, or Adji Kui were interpreted as a cluster of sites composing "oases" with agricultural fields around the walled structures (Sarianidi 1986). However, the oasis model did not consider broader exploitations of the agricultural landscape, such as opportunistic agriculture. The areas between these site cluster areas were interpreted as grazing or hunting areas with no crop cultivation (see a representative picture of this model in Hiebert 1994a:Fig.8.2).

The "oasis model," albeit questioned by the AMMD, remains popular (e.g., Kohl 1984; Sarianidi 1990a; Hiebert 1994a). These oases were reconstructed with proxy data from large centers, such as Gonur, in which Moore et al. (1994) envisioned a series of canals with fields and orchards in proximity of the sites with the desert beyond. In this landscape, human occupation was inevitably bound to the artificial oasis environment, while the desert constituted a barrier for a widespread occupation. Therefore, everything in between the oases was an empty landscape.

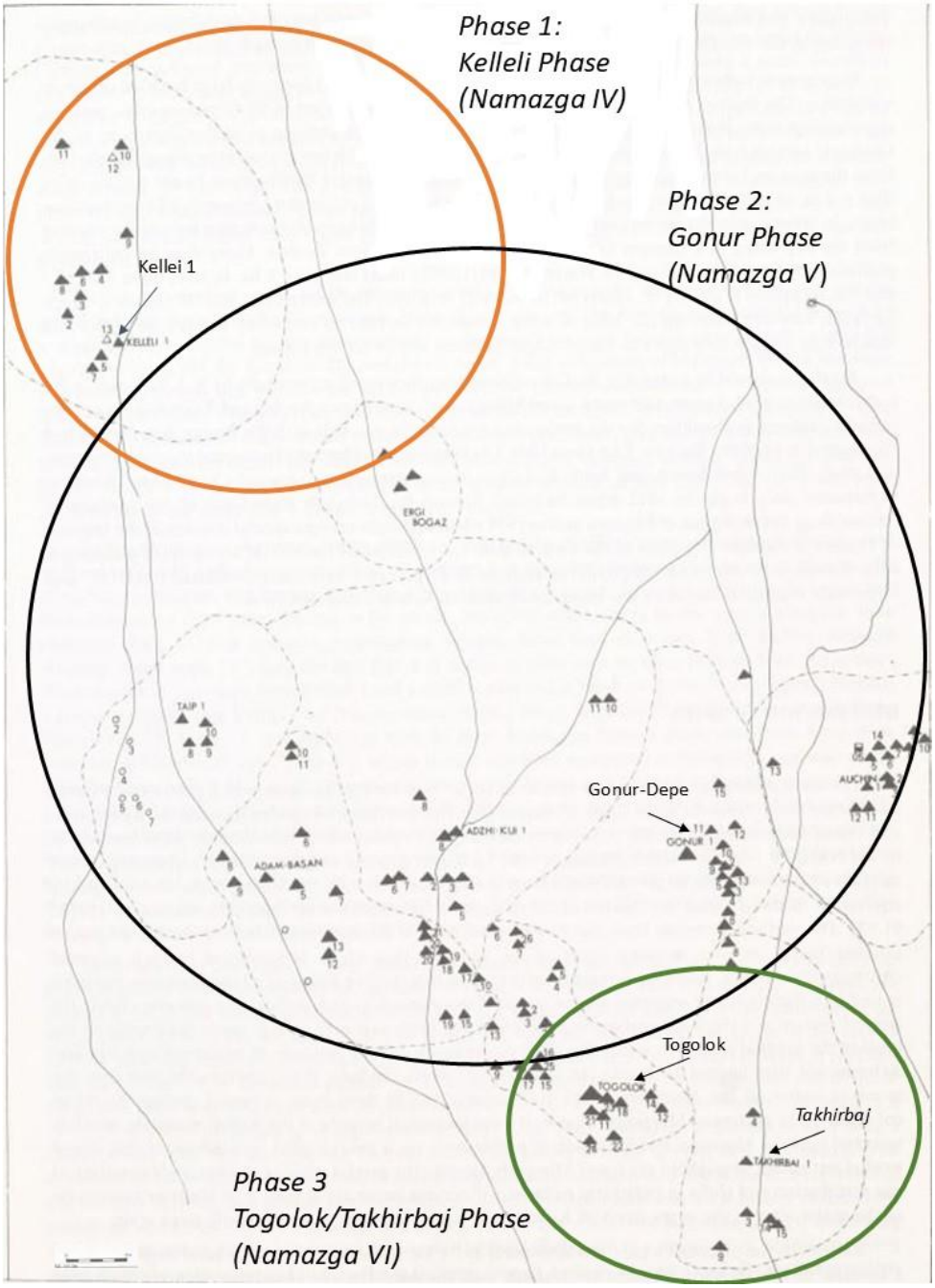


Figure 3.10 The map illustrates the early "oasis" model, depicting the chronological sequence of the Murghab occupation and the migration of sites towards the south. Phase 1 is characterized by the Kelleli Phase (Namazga IV), followed by Phase 2, known as the Gonur Phase (Namazga V), and Phase 3, identified as the Takhirbaj/Togolok Phase (Namazga VI) according to an early Soviet periodization. (adapted from Kohl 1984: Map 16B).

The oasis model was also linked to a chronological periodization of the Murghab. Three main chronological periods were associated with the north, central and south occupation sequence of the Murghab during the Middle and Late Bronze Age (Kohl 1984:143–144) (Figure 3.10). In this chronological model, the first phase (*Kelleli Phase*) is associated with the occupation of the north of the alluvial fan and dated to the Namazga V period (ca. 2500–2300 BCE). The second phase (*Gonur Phase*) is associated with the main flourishing of the BMAC in terms of trade and material culture (ca. 2300–1800 BCE). This period characterizes the central area of the northern Murghab, including the main site of Gonur North. The last phase (*Togolok/Takhirbaj Phase*) is associated with a southward shift of sites and the de-urbanization of the Murghab, as well as the appearance of sites with Andronovo (ICW) pottery assemblages (ca. 1800–1500 BCE) (Kohl 1992). In this model, the chronological progression (from Middle to Late) aligns with a progressively southward shift of the sites. This chronological and spatial sequence starts from the assumption that most of the sites had a one-period occupation spanning a few hundred years. However, excavations of sites such as Adji Kui 1 and 9 and possibly Gonur (Lyonnet and Dubova 2021a) have revealed a more extended occupation (Luneau 2019). Likewise, Late Bronze Age assemblages have also been found in the northern area of the Murghab, and layers from Togolok 1 (previously linked to the last phase of the Bronze Age) have been radiocarbon dated to the Middle Bronze Age (Cerasetti et al. 2022). As argued elsewhere (Cremaschi 1998; Salvatori 2008a), the early BMAC phases in the southern area of the Murghab can also be hidden under meters of alluvium, which has potentially masked a widespread occupation of the southern fan since the early periods (i.e., early-Middle Bronze Age).

All in all, it is likely that large areas of the Murghab were occupied during the Middle Bronze Age, but only in the northern area were sites short-lived (i.e., Kelleli 3 and 4) due to lack of water from the river by the late 3rd millennium BCE (Hiebert 1994a:17–20). The absence of occupation in the northern areas during the subsequent Iron Age period further supports the idea of a general southward retraction of the sites, as argued by Salvatori (2008a) (Figure 3.11).

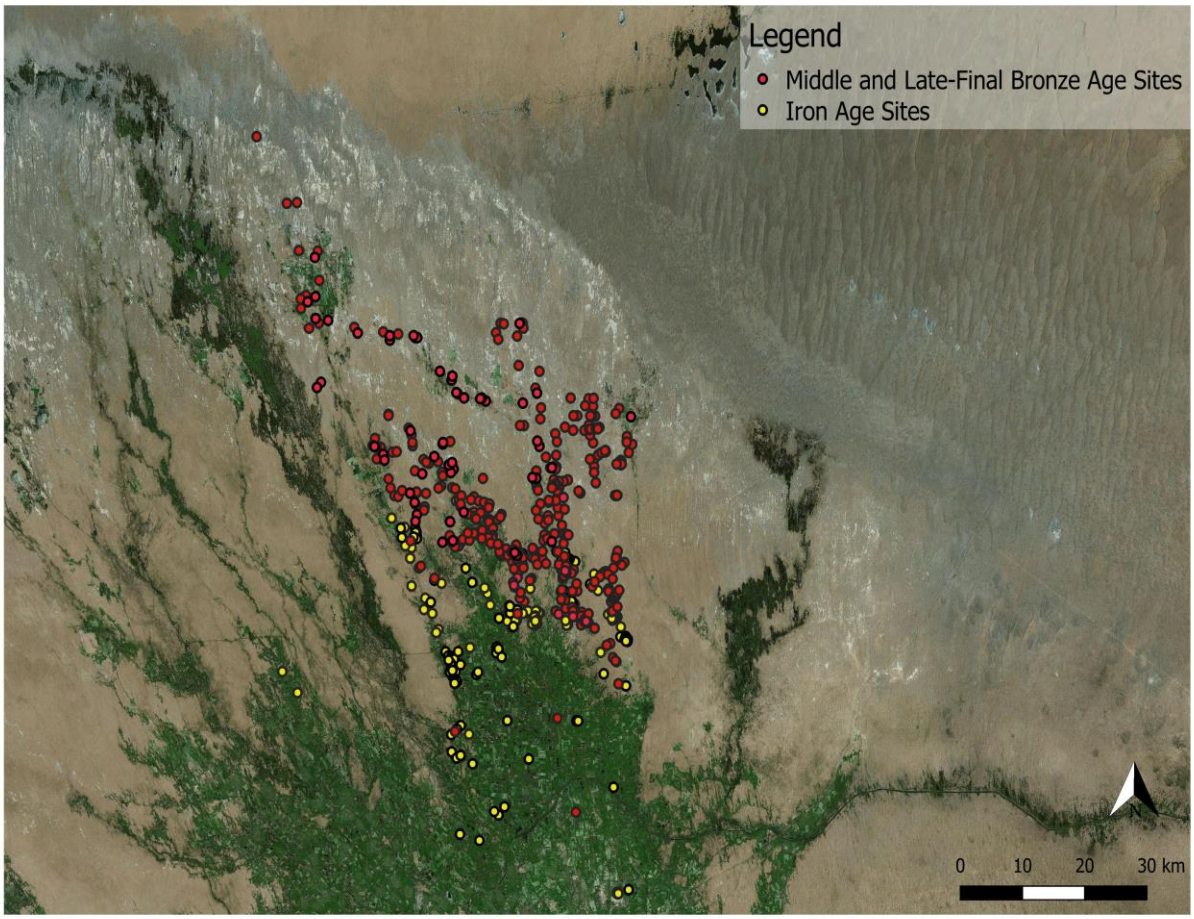


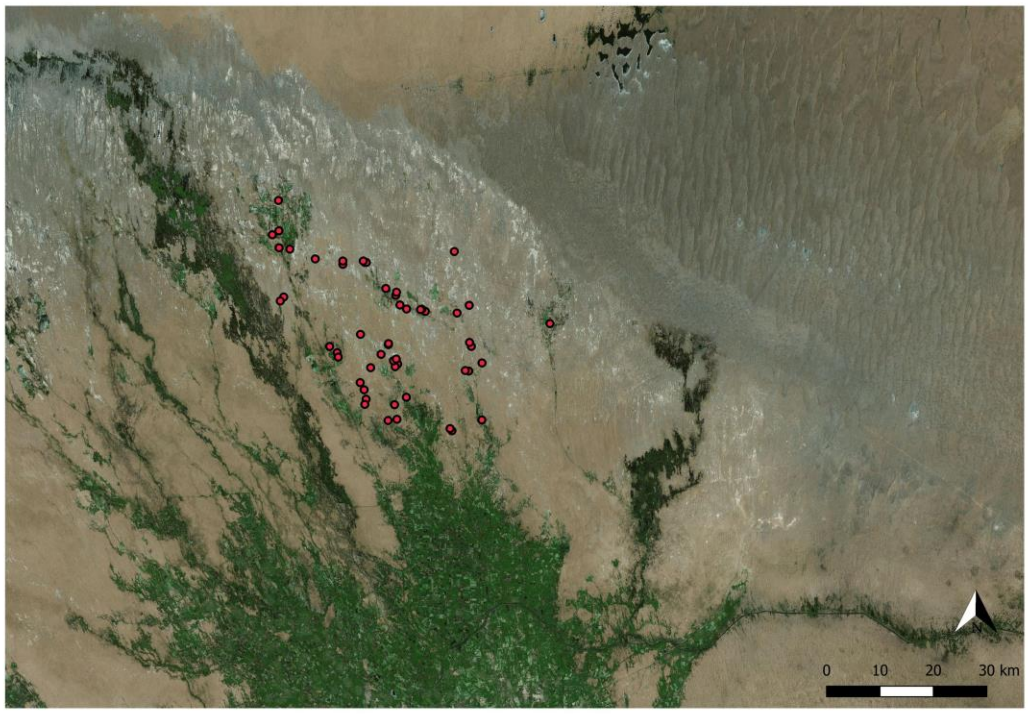
Figure 3.11 The figure shows the presence of Bronze and Iron Age sites, with the latest mainly located in the southern area (AMMD data/Landsat 8 image).

The survey by AMMD also suggest a strong reduction of sites in the northern part of the Murghab alluvial fan (Figure 3.11). This shift is likely linked to the retraction of the alluvial fan during the mid-2nd millennium BCE. This hypothesis, as discussed previously in the thesis, is supported by Cremaschi (1998:17–19), who identified several aeolian deposits from exposed ancient channels sections across the Murghab that have been radiocarbon dated to the Late Bronze Age. This would support a model in which from the Late Bronze Age most of the channels in the distal area of the alluvial fan became inactive or started to have a strong decrease in water level. This did not lead to the complete disappearance of Iron Age sites, as some still remain in the northern fringe of the alluvial fan. This suggests that the activity of the channels was not entirely discontinued.

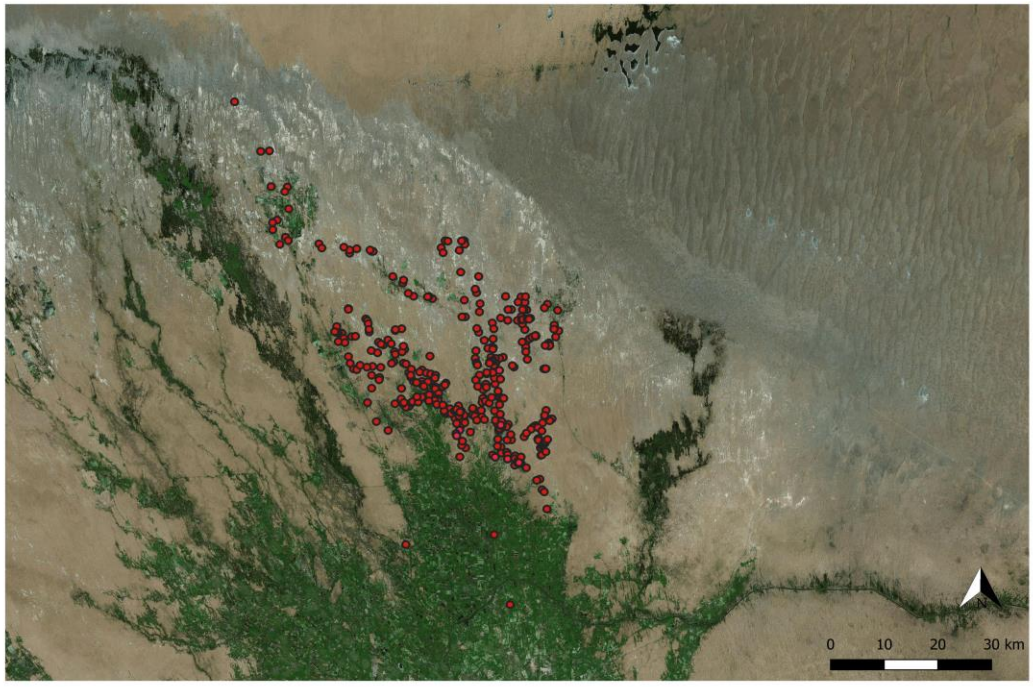
The AMMD survey revealed numerous sites dating to the Middle and Late Bronze Age, as well as the Iron Age (Namazga V and VI). The distribution of these settlements does not fit with the notion that the Murghab was solely characterized by discrete oases as argued by Soviet scholars (Sarianidi 1990a; Cattani and Salvatori 2008). The numerous sites in what was believed to be an almost empty landscape, in addition to an initial reconstruction of paleochannels, led the AMMD to propose a new landscape model. The AMMD team, therefore, argued for an open and well-watered landscape with numerous sites located along the channels during the Middle Bronze Age (Salvatori 2008a:59). This alluvial landscape underwent a process of aridification at the mid-2nd millennium BCE, resulting in a shift towards the south during the Early Iron Age (1300–900 BCE) (Cremaschi 1998). In this model, during the Middle and early Late Bronze Age periods, the Murghab landscape was occupied by a settlement system on a continuous agricultural plain (Salvatori 2008a).

However, the AMMD model did not challenge the centrality of Gonur. Based on Thiessen polygons, Salvatori (2008a:61–62) identified three typologies of sites and Gonur North was the center, below which there were a number of second-rank centers, such as Adji Kui 9. This Middle Bronze Age settlement system changed drastically in the subsequent Late Bronze Age as the main settlements decreased in size (e.g., from Gonur North to the small Gonur South) and we see the appearance of hundreds of small sites across the fan not present during the Middle Bronze Age (Figure 3.12B).

According to Salvatori (2008a:Fig. 5.5), in the Late Bronze Age there was no predominant center but rather a horizontal settlement system. In addition, according to Wright (2008:Fig. 4.2), there was no decrease in the Murghab population, which from large centers was now spread out into smaller settlements (but see discussion in Chapter 7 about this interpretation). While the AMMD model of a continuous agricultural landscape remains pertinent, it is subject to several limitations and challenges, which will be outlined briefly in the following section. In light of the data presented in this thesis, these limitations will be further explored and discussed in Chapter 7.



A



B

Figure 3.12 A) Distribution of Middle Bronze Age sites. B) Distribution of Late and Final Bronze Age sites. The Late and Final Bronze Age period shows a considerable increase in the number of settlements along with a decrease in size of the main mounds (AMMD Project data/Landsat 8 image).

3.4.2 Further Models of Landscape Development

The landscape and agricultural models put forth by Soviet and AMMD scholars are characterized by a fundamental dichotomy. On one hand, there exists the oasis-based model, which posits a desert landscape punctuated by settlements clustered within oases. In contrast, the AMMD model portrays a vast, well-watered, and cultivated plain. However, both models fail to consider the intricacies of landscape exploitation, as outlined in section 3.3.3. In this context, I argue that the mosaic of landscapes uses has not been adequately addressed. The resilience and possible varieties of subsistence strategies of local communities, as well as the local paleoclimate, were certainly reflected in different land exploitation and water management practices that will be presented in the two case studies.

The recent investigation and the data collected by Markofsky (2017) in the area of Egri Bogaz in the northern fan suggest a diverse landscapes with various environments where small-scale agriculture was possible. Certainly, this interpretation acknowledges the complexity of agricultural exploitation and land management in the Murghab and has advantages over previous models. However, while Markofsky's investigation addresses local patterns of landscape use (Markofsky et al. 2017), it does not consider the entire spectrum of farming, husbandry and irrigation practices. The extent to which rural communities might have exploited water channels is not investigated by Markofsky. Nevertheless, Markofsky's regional study of settlement dynamics constitutes a significant starting point for the present research and will be further discussed in the final chapter.
Furthermore, in the concluding chapter, both the AMMD and oasis models will be reassessed. While the AMMD model appropriately acknowledges the presence of a landscape featuring paleochannels and numerous settlements, it lacks a comprehensive exploration of local landscape management and the extent of variation among local areas in the Murghab. The examination of both case studies and a holistic approach to the data will prompt a reevaluation of the oasis model.

3.5 The Theoretical Context of Hydrological Research

The *Archaeological Landscape of the Ancient Near East* by T. J. Wilkinson (2003) can be regarded as one of the most influential works about landscape archaeology in West Asia. Wilkinson articulates a view of the landscape in which it "must therefore been seen as both actively influencing the lives of the inhabitants as well as being, in turn, heavily influenced by the activities of those inhabitants" (Wilkinson 2003:6). In the monograph he rightly focuses on the complexities of the landscape, and social and historical factors, outlining an integrated approach to investigate the environment. Wilkinson's works are, however, the climax of a long process.

Landscape studies began after World War I with an increased amount of data, such as aerial photos, produced from military campaigns in the Middle East. Pioneering works on the landscape included those by Stein (1938; 1940) or Bowen (1958). These studies clearly pointed to the role played by irrigation. Water resources and irrigation channels were crucial to understanding settlements evolution pattern (Wilkinson 2003: 71). The acknowledgment of the importance of the hydrological landscape resulted in theories linking social complexity and hydrological infrastructures.

The often-cited work by Karl Wittfogel (1957) was influential in many respects and still triggers discussions on the link between water and power (Mori 2020). Wittfogel argued that the development of a massive irrigation network led to an organizational hierarchy and social complexity that were crucial for managing hydrological infrastructure. This theory was subsequently criticized for its deterministic approach (e.g., Andrianov 1969; Hunt 1988). More recently, the investigation of ancient irrigation systems has occurred as part of "human niche construction theory," which contrast with Wittfogel's view.

The construction of irrigation systems, or the management of natural channels, clearly constitutes an alteration of the local environment (Kaptijn 2015). As argued by Wilkinson et al. (2012:157), "human niche construction can be seen to have operated where small-

scale communities built upon naturally occurring conditions to divert water to nearby localities with the result that incipient water management then created the conditions for future developments." These future developments included large irrigation systems planned and managed on a state level, such as some examples in Mesopotamia (e.g., Morandi-Bonacossi 2017:134). However, large irrigation systems do not necessarily require a bureaucratic state for their management. Hunt (1988) brilliantly demonstrated that many irrigation systems of considerable size (458,000 ha) can be operated by small-scale communities. The human dimension and the daily practice by local agencies are crucial aspects to consider (Ertsen 2010). Further, it can be argued that "an irrigation system may be initiated under central rule, by a strong state, but daily practices on the smaller scale would still determine success or failure of irrigation considerably" regardless of its state control (Ertsen 2010:167). The success or failure, even in a state planned irrigation system depends on the skill and work of the local agents, for example in the modern Gezira Plain in Sudan (Ertsen 2016:67-69). Similarly, cuneiform tablets from Mesopotamia inform us that workers from local communities were instrumental in maintaining the canals on a daily basis (Tamburrino 2010:45; Vidale 2018). Ethnographic analysis from southern Iraq by Fernea (1970)[27] demonstrated that the management and the control of irrigation networks were organized by local tribes at a local, non-hierarchical level.

More recently, Lamberg-Karlovsky (2016:26), building on Crumley (1995), suggested a "heterarchical model" for managing irrigation systems, which includes cooperation, interaction, and interdependence between communities. The current data from the Murghab, likewise, suggests variability in the management of the agricultural landscape and a pivotal role for local agents. Hence, it is imperative to delve into the management of the water channel system and the potential roles of communities within it. Consequently, the exploration of local ecologies and potential agricultural and irrigation practices emerges as a central focus of this study. Understanding how communities interacted with and managed water resources can provide invaluable insights into the

[27] Quoted in Lamberg-Karlovsky 2016.

socio-economic dynamics and environmental adaptations of communities within the Murghab region during the Bronze Age.

- **Investigation of the Water Channel System**

The study of irrigated landscapes is not new. The first attempts to link watercourses with archaeological sites dates back to the 1937 "Diyala Basin Archaeological Project" in Mesopotamia (Jacobsen 1960). Jacobson identified the dates of archaeological sites based on their archaeological materials and, in turn, dated the channel networks on those. This method was later refined by other scholars (see Chapter 4). The groundbreaking work of Adams (1965) marks a turning point in the investigation of irrigated landscapes (Yoffee 1997). The main premise was that settlements exist in proximity of water resources, such as water channels. By surveying, mapping, and collecting archaeological materials, along with the analysis of aerial photos, linear patterns of sites were interpreted as the presence of ancient watercourses (Adams 1957; 1958). Adams undertook the most empirical and extensive investigations of the landscape in Southern Mesopotamia. Later on, Steinkeller (2007), on the basis of the archives from the 3rd millennium BCE, correlated cities and towns initially identified by Adams (Hritz et al. 2020).

These early studies of Jacobsen and Adams created a framework for the investigation of ancient hydrological landscapes. This approach was later augmented with the use of remote sensing analysis, GIS, and geological analyses (e.g., Hritz and Wilkinson 2006; Hritz 2010; Ur and Reade 2015; Jotheri et al. 2018). One of the most remarkable results of Adams' work was his insight that human agents formed and transformed the physical landscape through the construction of dams, artificial canals, and the irrigation of agricultural fields.

The work by Wilkinson (2003; 2014), however, initiated a new stage in the investigation of the "Near Eastern" irrigated landscapes. His initial work concentrated on the systematic off-site survey between tells and the investigation of the farming landscape in

dry farming regions (Wilkinson 2003). This led to a great increase in our archaeological perception of these areas and how to understand episodes of urbanization and de-urbanization. The work included ground cores, test pits, and geomorphological and sedimentary analysis, along with absolute dating of irrigation systems. In short, Wilkinson's investigations demonstrated a crucial importance in our understanding of analyzing farming landscapes, including land use, irrigation, and manuring, using a multidisciplinary approach.

The analysis of the Mesopotamian landscape differs in several aspects from that of the Murghab region. Firstly, Mesopotamia is characterized by the presence of two major rivers, the Tigris and Euphrates. The primary channels in central and southern Mesopotamia often feature elevated levees and overbank deposits, which are frequently identifiable through satellite analysis. Additionally, the presence of elevated levees contributes to the formation of crevasse splays, a defining feature of southern Mesopotamia (Jotheri et al. 2018). Another distinguishing characteristic is the abundance of artificial channels, canals, weirs, and gates, often sponsored by the state, which supplied water to cities and agricultural lands (Morandi Bonacossi 2017). Textual sources describe how these channels and canals were meticulously managed by local communities, as discussed previously. Consequently, agricultural land exploitation in Mesopotamia takes on different forms compared to the Murghab region, where many of these natural and artificial features are absent. In this context, it is crucial to consider the peculiarity of the Murghab landscape without uncritically applying a "Mesopotamian model" of land use to a Central Asian region. However, despite such differences, contextual and multidisciplinary study of archaeological records and the absolute dating of ancient watercourses in Mesopotamia has proved to be the most effective method to analyze the fluvial landscape (Hritz et al. 2020). This methodology will be applied to this research as well. Therefore, the comprehensive model of landscape analysis delineated by Wilkinson and further developed by other scholars (e.g., Jotheri 2016) presents the most robust theoretical and methodological framework for investigating the irrigated landscape and its evolution in the Murghab region.

3.5.1 The Early Central Asian Context

Research in the Murghab region did not concentrate on the investigation of the landscape and its broader hydrological system until the 1990s. However, early Soviet research elsewhere in Central Asia, and in particular in the Aral Sea area, focused on irrigated landscapes that are worth mentioning. Multidisciplinary investigation in the 1930s and 1940s by the *Khorezm Expedition* led by S. P. Tolstov located several Neolithic and Bronze Age sites in the region and recorded ancient irrigation networks. According to Dolukhanov (2016), the interest of Soviet archaeologists in the irrigation system derived from the Marxist concept of the "Asian Model" of production that was based, among other aspects, on the irrigation system. This generated interest in investigating ancient hydrological landscapes in some regions of Central Asia.

Andrianov, building on the early investigation of the irrigation system by Tolstov (1948), developed a new and innovative multidisciplinary approach that included the analysis of aerial photos and test pits of the ancient channels in the lower Amu-darya and the Aral Sea area (Adrianov 1969). His groundbreaking study of ancient irrigation, the study of land formation, and the characteristics of local deposits, such as the *takyr*, are of great importance in this research. Further, the identification of Bronze Age canals and the management of ancient agricultural fields provided crucial research and established a methodological landmark for Central Asian landscape studies (Andrianov 2016:137–141).

Andrianov's approach was also applied in southern Turkmenistan by Lisitsina (1978) at the Geoksyur Oasis in the Tedjen alluvial fan, where aerial photos were processed for the investigation of early paleochannels and agricultural areas. Investigations with test pits revealed the presence of several ancient channels dated to the Chalcolithic period that will be further discussed in Chapter 7.

All in all, the theoretical discussions in Central and West Asia mentioned above serve as the foundation for investigating ancient water systems. This study seeks to advance previous theoretical and methodological approaches by employing remote sensing, surveying, and geoarchaeological analysis to examine the water channel systems of the ancient Murghab, with a focus on specific case study areas (refer to Chapter 4 for the methodology). Through interdisciplinary analysis, the research aims to explore various unknown ancient watercourses and their connection to the local settlement patterns. By studying data from micro-regions, the argument is made that a factual comprehension can elucidate how local communities utilized land and water resources in different ways.

3.6 Summary

In this chapter I have introduced the history of archaeology in the Murghab region, focusing on the Bronze Age period. The early investigation of the Murghab by the Soviet scholars concentrated on the main settlement clusters of the region, giving rise to the "oasis model." This model envisioned discrete clusters of sites (i.e., oases) in an almost arid environment. These investigations had the great merit of uncovering a crucial region in Central Asia and brought to light monumental sites such us Gonur North. Subsequently, during the 1990s the survey by the AMMD Project over the northeastern area of the Murghab identified numerous other sites dated to the Bronze and Iron Ages, including sites with Andronovo (ICW) ceramics. The presence of many rural sites across the landscape was interpreted by the AMMD as evidence that during the Middle and Late Bronze Age, the Murghab was an extensive agricultural plain with numerous channels. During the mid-2nd millennium BCE the region probably underwent an aridification process, which had a particular impact on the distal areas of the alluvial fan. The presence during this period of small, rural sites, with Andronovo (ICW) ceramics were interpreted as "exotic" material from northern regions. The existence of these non-BMAC pottery assemblages in the Murghab was associated with pastoral groups by scholars. However, botanical remains from rural sites reveal that agriculture was practiced and a link between

pottery assemblages and the subsistence economy should be revised. Although water resources have been regarded as crucial by all scholars working in the region, little research has focused on the Murghab hydrological landscape, and the micro-scale agricultural and irrigation practices.

Hence, this research delves into the hydrological landscape using a multidisciplinary approach primarily pioneered by scholars in West Asia. The specifics of this approach will be elaborated upon in the following chapter.