Settlement Scaling and Urban Infrastructure

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A comparative Approach to Settlements from the Ancient Indus society

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For my family

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Table of Contents

List of Tables

List of Figures

CHAPTER 1

The question of urbanism and the archaeology of ancient societies

1.1 Introduction

A recent report by the United Nations (2018) suggests that 55% of the world's population reside in urban areas. The pace of urbanization in the modern world is fast; in 1950, 30% of the world's population was urban, and by 2050, this figure is projected to increase to 68% (United Nations, 2018). There is, however, significant variation in urbanization levels among geographic regions. The most urbanized include North America (82%), Latin America and the Caribbean (81%), Europe (74%), and Oceania (68%). In contrast, Africa (43%) is the least urbanized; while in Asia, about 50% live in urban areas today. Several of the most densely populated and largest cities of the world are located in Asia, including the global top three of Tokyo (37 million inhabitants), New Delhi (29 million,) and Shanghai (26 million) (United Nations, 2018). Ongoing trends towards an increasingly urbanized world have a series of social, economic, and environmental consequences that influence the very future of the Earth as a habitat. For instance, urban encroachment to fertile soils for crop production, growing population rates, competition from other land uses, and converting additional land for agriculture contribute to climate change and biodiversity loss that result in enhanced and heightened frequencies of extreme events, including pest outbreaks, flooding, and droughts (Barthel, et al. 2019). Increasing urban populations at the global and continental scales are largely associated with a decreasing share of food producers and agricultural communities, which further threatens the integrity and functions of societies and ecosystems.

Hence, there is little doubt that urban change is one of our most urgent challenges. Archaeology can contribute a long-term analytical perspective on urban processes as well as generate data on urban models different from those observed in the present. Indeed, understanding the social and demographic processes that drive urbanism and its consequences has been recognized as a grand challenge for contemporary archaeology (Kintigh et al., 2014):

> *The emergence and nature of cities are central themes for archaeologists who study complex societies and for geographers and historians who investigate long-term urban developments. Archaeological research is uniquely positioned to address questions with contemporary relevance. What conditions stimulate or discourage large-scale aggregation? What are urban successes, and why do some cities succeed over long periods while others fail? What roles do network effects and innovation (both economic and artistic) play in a city's development and success? How do we measure and evaluate persistence without overlooking change as a constant factor of urban life?* (Kintigh et al., 2014:6)

Urbanism is an immersive subject that addresses the forms, functions, characteristics, and development of human settlements (Hein, 2017). Generally, urban development results in a series of complex socio-economic, socio-cultural, and environmental transformations with different intentional and unintentional payoffs and tradeoffs for human wellbeing. Evidence of early urban systems has been discovered in several different regions of the world, including Eurasia, Africa, and the Americas. Asia has a particularly deep past record of urbanization starting about 6000 years ago, with early cities developing as part of the growth of early state-level societies in Mesopotamia (c. 4000 BCE), Indus Valley (c. 2600 BCE), and China (722 BCE) (Smith, 2019). The earliest unequivocal evidence of early urban settlements has been discovered in the Mesopotamian region, primarily in present-day Iraq but extending into northeastern Syria and southeastern Turkey, where several ancient urban settlements emerged between the Tigris and the Euphrates, drawing on these river systems for irrigated agriculture (Ur, 2014). Another region with early urban development is the drainage system of Indus River and associated areas in present-day Pakistan, India, Afghanistan, and Iran, where the Indus or Harappan society emerged in the early to mid-3rd millennium BCE (Shaffer, 1992). The archaeological remains of the Indus society are distributed over a geographically extensive region with significant biogeophysical diversity (see Chapter 3). This region will be in focus in the present thesis.

By the 3rd millennium BCE, archaic state-level urban societies had emerged in Mesopotamia and the Indus Valley regions (Jansen, 1984; Ur et al., 2007). While archaeological research examining urban development (supplemented by historical documents in the case of Mesopotamia) offers records of these societies' successes and failures over thousands of years (Marcus & Sabloff, 2008), our detailed knowledge about the economic, political, and social dimensions of urban societies and of long-term urban processes in both regions is still limited. A particularly contentious issue is socio-political structure and organization; while the data indicate socio-political systems of institutionalized hierarchies in the Mesopotamian statehood societies, these indicators (e.g., kingship, palaces) are missing or equivocal in the archaeological records of the ancient Indus. Hence, the complexities of horizontal and vertical differentiation in the social structure of the Indus society are still poorly understood. One reason for this lacuna is the lack of regional surveys and settlement mapping focused on generating data that shed light on this aspect of urban growth. In the Indus Valley region, limitations include that several sub regions still lack systematic survey, settlement size estimates are ambiguous or inaccurate, and a substantial share of excavations at key Indus urban sites were conducted in the early to mid-20th century, without access to modern methodological approaches and techniques of detailed excavation documentation and data retrieval and recording. Hence, despite the importance of the Indus society and its settlements in urban history globally, several aspects, such as systems of administration and leadership, the socio-cultural system, and the social structure, remain remarkably elusive.

These problems limit our understanding of the processes of the initial period of urban development in the Indus Valley region. The available archaeological record of ancient Indus society documents some special and unique urban settlements that are key to developing a better understanding of the challenges and limitations that the environment posed on the development of urban settlements in this highly diverse bio geophysical region. The urban settlement site at Ganweriwala, dated 3200-1900 BCE and located in the arid region of Cholistan in eastern Pakistan that today lacks any surface water sources, is a particularly interesting case in point. Some previous studies at Ganweriwala suggested that the site was a major urban center of the Cholistan region during 2600-1900 BCE and this has been debated because of its large size, environment and significant artefacts (Mughal, 1998). However, previous studies do not address its urban characteristics and development in relation to other known urban settlements.

For this reason, the focus of this study is the Indus regional urban development and particularly the larger urban settlements with a special focus on Ganweriwala site. Variabilities among the known five major urban centers of the Indus society are analysed to develop an urban infrastructure that can contribute to a better understanding of the Indus society and its environment. According to the American Heritage Dictionary the term infrastructure generally refers to an underlying framework or basic features of an organization or system (American Heritage Dictionary, 2011). I used this concept in present research to understand the Indus urban system by comparing variabilities among known urban centers and the developing urban infrastructure of the Indus settlements. Based on the various variabilities of different characteristics among large settlements, they are scaled at hierarchical order and thus develop an urban infrastructure. The urban infrastructure of Indus settlements helps to understand socio-economic, socio- cultural and environmental regional variations.

In addition, the similarities and differences of larger Indus settlements are compared with urban settlements and systems in the Mesopotamian region to trace out major variabilities between these two early macro-urban regions.

1.2 Aim, objective and research questions

In the existing literature, the large urban centers of the Indus are often analysed within the frameworks of different socio-political models such as there is much emphasis that Mohenjo Daro, Harappa, Dholavira, Ganweriwala, and Rakhigarhi were all independent city states. The absence of palaces, temples, kingship or centralized figures suggest that Indus cities were not organized as theocratic city states or monarchies, but they seem to be republics or oligarchies of the early historic period (Kenoyer, 1997).

However, there is still a lack of suitable socio-political models (Kenoyer, 1998). In addition, as to the Indus, one of the major difficulties is that there is little available direct archaeological evidence as to the possible existence of state(s), which could be used to address the socio-politics of Indus society. Addressing questions of possible statehood and its development, we need to know much more about the workings of individual sites, their similarities and differences, and their interactions. Thus, in this thesis, the topic of statehood is not addressed directly, while I instead focus on exploring the archaeological evidence from individual sites, and their comparison. The lack of evidence and the complex nature of Indus cities still limits our understanding about the socio-cultural, economic, and political organisation, and its variabilities among Indus cities.

For this reason, the principal aim of this research is to analyse different characteristics during urban development of Indus cities from 2600 BCE to 1900 BCE by comparing the available general data from the larger settlements within the framework of a set of different theoretical and methodological approaches. The main work is inspired by the empirical urban theory and the urban infrastructure and settlement scaling theory (Merton, 1948; Giddens, 1984; Ortman, et al,. 2014), see chapter 2 for more details.

The examination focuses on three specific components of these urban systems: urban development, physical attributes of settlements (e.g., size, architecture, settlement plan, streets, and fortification), and the natural environment. These three parameters to larger settlements are presented and discussed in detail in chapter 2.

When examining the Indus material, special attention is given to an unexplored larger settlement named Ganweriwala site. The settlement was discovered in 1974 (Mughal, 1997), and although surface evidence suggests that Ganweriwala was one of five major Indus cities, no excavations or other subsurface data collection (e.g., coring) has been conducted there, and it has received insufficient attention in the archaeological literature on Indus urbanism. Hence, focusing on Ganweriwala here will contribute insights on the development and nature of this urban site to the discussion about regional urban development and will add important dimensions towards the urban infrastructure and regional environment. Furthermore, this thesis includes comparative data from Mesopotamia that is analysed using the same basic parameters. However, comparison with Mesopotamia is peripheral but it produces some interesting results. The two macro-regions are then compared, and their similarities and differences are discussed.

In pursuit of the overarching aim, the study is driven by three major research questions operating under a set of different theories and methods.

1. What are the socio-cultural, socio-economic, and characteristics of larger Indus urban centers, and what are the major variabilities among them?
2. The socio-cultural, socio-economic, and urban characteristics of five larger settlements within the Indus society are analysed with a focus on the above-mentioned three parameters. I also include the archaeological material from Ganweriwala site and address the socio-cultural, socio-economic, and urban characteristics.
3. What are the different urban scales of known large urban centers?
4. By analysing the variabilities of the above-mentioned three main parameters of major urban settlements, I used spatial scale units that represent the hierarchical order of the cities and help to understand urban infrastructure during 2600-1900 BCE. Indus settlement scales constitute a relatively new conceptual framework that is addressed in chapter 2.
5. What are the similarities and differences of urban development and processes between Indus and Mesopotamian societies?

Indus urban infrastructure is compared with that of Mesopotamia to trace the similarities and variabilities between the two regions. The objective of this question is to develop a general understanding of urban development and variabilities between the two earliest urban regions of the world.

1.3 Status of available archaeological data

Despite the region's crucial roles in early urban history, research on the Mesopotamian and Indus societies is in a paradoxical situation. It is difficult to gain detailed knowledge about the settlements in both regions. The investigations are limited to the Upper level of settlements; as a result, there is limited information about the deeper, i.e. earlier, levels of settlements. Many settlements have never been examined by archaeological excavation. Thus, a significant degree of investigation has depended upon published sources such as reports, field registers, books, and journal articles.

In the case of Indus settlement analysis, the archaeological data from Ganweriwala settlement is a primary source of this research. The archaeological data is divided by two major categories; category 1 is the artefacts collected by the previous archaeologists and named legacy data, and category 2 is collected by the author and named the Gulzar collection. Ganweriwala site is considered a major urban center, but its material has never been studied prior to this work (Mughal, 1997). Different archaeologists collected the material at different times with a major focus on the settlement size. All previous archaeologists collected random artefacts from the site, but there is no report available about these collections.

The collected material was placed at two different museums in Pakistan: the Lahore Fort Museum and the Harappa Museum. Most of the material was collected in 1976, 2002, 2007, and 2011. The material consists of a variety of different types of artefacts such as a dish on a stand, beads, figurines, clay tablets, serving dishes, and cooking pots.

In 2013 and 2014, I studied archaeological data from museums. The artefact analysis and Ganweriwala settlement survey were performed by the permission of Department of Punjab Archaeology, Pakistan.

In 2015, I surveyed Ganweriwala settlement with a major focus on physical examination of the settlement (see chapters 5 and 6 for details). Legacy data study and physical survey of Ganweriwala settlement suggest that the settlement contains significant artefacts of the urban period and future excavations at the settlement can produce promising results to understand the socio-cultural, economic, and political dynamics of the Indus society.

1.4 Organization of thesis

This study is organized in 9 chapters. Chapter 1 is dedicated to the aim of the study and the introduction to the regions being studied. Chapter 2 outlines the theoretical framework and comparative method. Here, the central defining issue is discussed within the framework of comparative method and urban theories, with discrete components such as urbanism, region, and environment. Chapter 3 provides a general introduction and history of research of Indus society.

Chapter 4 is about the surface survey and archaeological discoveries from Ganweriwala. Chapter 5 deals with the analysis of five large settlements. Chapter 6 is dedicated to the analytical study of selected ceramics using the SEM-EDX method. Chapter 7 focuses on the comparative study of Mohenjo Daro, Harappa, Dholavira, and Rakhigarhi in relation to Ganweriwala site; it analyses the variabilities among the five Indus cities and summarizes different scales. Chapter 8 compares the urban development and processes at the Indus and Mesopotamian regions.

Chapter 9 summarizes the results of the study and suggests directions for future research.

CHAPTER 2

Theoretical and methodological approaches to human settlements and urban development

This chapter deals with the theoretical and methodological framework of the thesis. The overall method applied for the present research is the comparative method. The central defining issues are addressed, inspired by a set of different theories related to urbanism (Childe, 1951; Parsons, 1968; Smith, 2012).

The archaeological material is analysed by a combination of four different methods known as attribute-based analysis of settlements, settlement scaling, type-variety analysis of artefacts, and SEM-EDX analysis of artefacts. The results derived from these methods are compared to trace the variabilities. All these methods are briefly explained below.

2.1 Comparative approaches to urban settlements

'To claim any information at all other than the stone or potsherd that is discovered, is necessarily to presume knowledge of man and culture in general and to assume the existence of cultural regularities, however broadly conceived. Since each archaeological object and situation is unique, every archaeological reconstruction is analogy based on a number of such presumptions and assumptions' (Chang, 1967)

Bruce G. Trigger similarly stated that

> *'the most important issue confronting the social sciences is the extent to which human behaviour is shaped by factors that operate cross-culturally as opposed to factors that are unique to particular cultures' (Trigger, 2003)*

The overarching approach used in the present study is the comparative method, which is an effective tool to understand cultural variations and provides a better understanding of the complex patterns in ancient societies (Smith, 2012). It is also suggested that archaeology is inherently comparative, and it is necessary to understand the variation of material record (Smith & Peregrine, 2012). The comparative method in archaeology has been popular since the late 19th century and is particularly used to investigate at the broader inter-societal level.

The systematic comparative method originated from the cultural evolutionary work of sociologist Herbert Spencer. He defined evolution as a change from an indefinite, incoherent homogeneity, to a definite coherent homogeneity through continuous differentiations and integrations (Spencer, 1863). Later, he placed societies such as pre-Columbian Mexico, the Roman Empire, and Egypt into a broader comparative framework and attempted to construct a general law of the cultural evolution (Spencer, 1998). Another popular work is Lewis Henry Morgan's comparison in ancient societies to establish the universal sequence of cultural evolution. Morgan proposed the first evolutionary scheme by dividing ancient societies into the three broader categories of savagery, barbarism, and civilization (Morgan, 1963). These categories were developed based on specific technological innovations and food procurement methods. Robert McC. Adams adopted Morgan's evolutionary scheme to compare Mesopotamia with Pre-Hispanic Mexico (Adams, 1966).

However, this approach was soon replaced by the historical particularism that emphasises a variety of cultural historical processes. In the middle of last century, the approach of multi-linear evolution emerged (Steward, 1949). The multi-linear evolution approach suggested that similarities among societies are not universal, and instead, there are limited similarities among them. Both evolutionary and multi-linear evolutionary models sought common patterns, structure, and behaviour of the societies (Steward, 1979; Claessen & Skalnik , 1978).

The multi-linear evolutionary approach is associated with the neo-evolutionism ideas of different types of societies, such as bands, tribes, chiefdoms, and states (Steward, 1949; Service, 1962). Service's research focused on Mesopotamia and concluded that the early states evolved over time and shared several features despite being located in different parts of the world. He further divided these states into four societal types and identified states as the complex form (Service, 1962).

Above mentioned evolutionary typologies derived from ethnographic and historic case studies and the notion of ancient city or ancient state mostly derived from the long connections between rural and urban populations (Feinman & Marcus, 1998). Cities are usually studied to document a civilization or a state (Smith, 2003). However, Jennings and Earle questioned the association of elemental nature of cities and states. They argued that early urbanization suggests a common process in which urban settlements expand and emerged by the operation of small scale cooperative units and overarching political structure work through these groups. States work as a regionally organized polities, highly centralized and specialized government composed with a ruling class and a commoner class. Thus state formation is a multigenerational process (Jennings & Earle, 2016). It is too early to evaluate Feinman & Marcus or Jennings & Earle in relation to the Indus society, since the archaeological knowledge still not allows for such a discussion.

Vere Gordon Childe suggested that archaeologists needed to focus on cross-cultural comparisons using archaeological data (Childe, 1951). These early works were criticized by Boas and his students because the archaeological data were crude and lacked absolute dates (Giddens, 1984). The Boasian reaction halted the comparative research, but a second generation of evolutionists followed the comparative work based on better data and theory (Harris, 1968; Trigger, 2003).

Today, a very large number of archaeologists believe that archaeology is a comparative discipline. Several different approaches have been used for better comparisons focusing on contrast or continuum, referred to as systematic or intensive comparative methods (Johnson & Earle , 1987; Peregrine, 2001; Smith, 2006; Blanton & Fargher, 2008). Some scholars analysed the archaeological data as long-term natural experiments that can provide a diachronic perspective (Feinman, 2012). Based on these assumptions, comparative analyses of archaeological societies with the contemporary world are useful to tackle present-day challenges such as climate change (Peregrine, 2018; Crumley, 2019).

There are several types and scales of comparative analysis, including large-scale comparisons and small-scale comparisons (Smith & Peregrine, 2012). A large-scale comparison involves a large number of the archaeological settlements and uses quantitative methods in the analyses. The goal of this type of comparison is to identify the relationship between the variables and the outcome of interest (Binford, 2001; Peregrine, 2004). This comparison of a large number of archaeological settlements is alternatively known as a variable-oriented comparison (Caramani, 2008). The latter, which is a study of a small number of settlements, is also known as an intensive comparison approach, a small-scale study, or a case-oriented study. The focus of small-scale comparison is often associated with greater contextualization and uses analyses based on qualitative methods. Small-scale comparisons analyse some divergent phenomena, such as social complexity or early state formation, through narrative discussion (Earle, 1997; Trigger, 2003).

Another type of comparative approach is the middle-ground comparison, which involves a moderate number of cases around 10 or 20 that are compared with a small number of variations. However, the difficulty with comparison lies in the selection of the analysis units that are associated with the aim of the investigator (Smith, 2010). Still, archaeologists are developing their own methods for productive comparisons.

For the present study, my investigations are strictly limited with the available data from the Indus settlements. The major problem with the comparison of Indus urban settlements is there are different levels of knowledge of each Indus urban center. For example, Mohenjo Daro and Harappa have been extensively excavated, but several other settlements such as Rakhigarhi have been less investigated and knowledge of Ganwerwiala is rare. To tackle this problem, my major focus is on the topography and available architectural details belonging to 2600-1900 BCE from the large Indus urban centers. Details of topography, settlement sizes, environment of known large urban centers are analysed and compared (for details see chapter 3 and chapter 7).

Both small-scale and large-scale comparisons are used in present study. The settlement data from Indus society is analysed on a smaller scale by focusing on five major urban centers. Additionally, the settlement data from the Diyala Plains region of Mesopotamia and one large settlement Uruk from the south Mesopotamia society are analysed. Thus, the results from the Indus society are compared with the Mesopotamian society at a large-scale that results in major similarities and differences between two ancient societies (for details see chapter 8).

2.1.1 Empirical Urban theory

For the present work, I found inspiration from the empirical urban theory, which was derived from the middle-range theory developed by sociologist Robert King Merton. Merton defined the middle-range theory as a set of several different theories developed by the investigation of empirical data to test a hypothesis (Merton, 1968). He described the gap between the limited number of empiricist studies and Parsons' grand abstract theory. He suggested that middle-range theory is intermediate to general theories of social systems, which are too remote from particular classes of social behaviour, organization, and change to account for what is observed.

Middle-range theory is principally used in sociology to guide empirical inquiry. As Merton describes, 'Middle-range theory involves abstractions, but they are close enough to observed data to be incorporated in propositions that permit empirical testing. Middle-range theories deal with delimited aspects of social phenomena' (Merton, 1968).

Considered as low-level theories rather than grand social theories, middle-range theories have been adopted by archaeologists and referred to as an idiosyncratic body of theory developed on formation processes such as static and dynamic poles of archaeological interpretation (Binford, 1977). Schiffer also referenced the importance of developing middle-range theories that address the empirical reality rather than more abstract theories (Schiffer, 1984). However, the middle-range theory has received rigorous critique by post-processual scholars such as Ian Hodder, who argued that the separation of levels and types of theory seems redundant (Hodder & Hutson, 1986).

Despite Hodder's view, the effectiveness of middle-range theories can be seen in different types of archaeological cases. Different parts of the world contain various types and levels of empirical record. For the construction of grand theories, the analysis of these data sets at a middle range is necessary. The evaluation of data at a middle range is a better solution than jumping from empirical inquiry to grand level theories. To understand urban process and development in past human societies, empirical urban theory provides a wide range of concepts depending on research questions.

This type of approach used in archaeological investigations, known as empirical urban theory, is actually not a generalized framework, but rather, provides an approach to develop a different set of theories (Smith, 2010). Empirical urban theory addresses social concepts concerning urbanism that have identifiable expressions in archaeological record and concerns with the material remains of the ancient cities (Hedström & Udehn , 2009). However, the concept of empirical theory described by Smith is borrowed from other social science subjects. Such as anthropologist Murray Leaf suggested that

"The term 'empirical theory' refers to something that can be verified or falsified based on shared experience. It does not work in the manner of a just-so story or an ideology. Ideologies are logically circular systems of claims and definitions designed to be held true no matter what; they usually include some claim to the effect that they do not describe mere appearances or mere individual experiences but rather something we cannot observe directly that lies behind them and produces them. Many social theories are of this nature" (Leaf, 2009).

As a result, I have chosen settlement scaling theory to elucidate the discussion in present research discussed below.

2.1.2 Urban infrastructure and settlement scaling

The social scientists and engineers define the term 'infrastructure' as the extensive landscape connectivities that can be constructed, maintained, and used by themselves, such as water management, road networks or streets, and bridges (Larkin, 2013). However, the word infrastructure originated from military parlance referring to fixed facilities such as air bases. The American Heritage Dictionary defines infrastructure as an underlying base or foundation, especially for an organization or system (Anon., 2000). An alternate definition describes infrastructure as the basic facilities, services, or installations needed for a community or society to function, such as transportation or communication systems (Edwards, 2003). Thus, infrastructure is designed to fulfil a physical function by providing waste management, water management, and communication. Due to higher population densities, urban centers are where infrastructure manifested (Smith, 2016). Scholars of urban studies have suggested that infrastructure is a way to understand culture, social change, and power (Star, 1999; Edwards, 2003). The study of infrastructure is a lesser-used concept in archaeology (Wilkinson, 2019). However, the study of infrastructure in relation to other indices – particularly with regard to urbanism – can produce interesting results that improve understanding of social structure. An approach to address the Indus urban infrastructure may provide a better understanding of Indus society, peoples, and the environment around 2600–1900 BCE. The study of infrastructure and urbanism is a broader issue, and therefore there is not such an effort available to address the urban infrastructure of the Indus society. Infrastructure in relation to urbanism can be defined in several directions – for example, roads, the canal system, water management, and the settlement scale. However, urban infrastructure is a relatively new concept that I adopted for the present study that emphasises the spatial scales of the urban centers. Studying urban infrastructure can be promising to understand the social structure of a society.

In archaeology, there are few works that address how urban infrastructure can be defined. Did ancient societies have different infrastructure from present-day infrastructure? Archaeologists have adopted different approaches to study societies. For instance, Wittfogel addressed irrigation systems as a major element to study the origin of societies (Wittfogel, 1957). Some archaeologists have studied landscape as a subsidiary factor, while others have studied globally comparative analysis of water management systems, but notably, they never used the term infrastructure in their literature (Snead, et al., 2009; Scarborough & Lucero, 2010). Thus, these elements such as water management, roads and streets, and settlements should be studied under a unified analytical framework to provide a better understanding of societies.

In this thesis, the term 'infrastructure' refers to urban scale and functions of the network of large, known, Indus settlements. It is important to note this term does not pertain to commercial infrastructure, such as the streets, water management, or the road network. Instead, 'infrastructure' refers to the social and spatial characteristics of the settlements, such as the location, settlement plan, and setting. The social and spatial characteristics of urban centers combine to inform the various scales of settlements that exist and function in relation to provide services of its hinterland. That network of various types and forms of settlements constitutes the urban infrastructure, which when studied may provide a better understanding of Indus social structure.

To understand infrastructure, 'scale' is an effective determinant (Edwards, 2003). This term is at times easy to define and difficult to grasp at other times. In archaeology, 'scale' is an analytical framework, a lived experience and a concept. In the dictionary, there are a number of different terms for 'scale', such as a ratio of representation or relative extent or a system of relative values or correspondence. In settlement scaling theory, 'scale' is a quantification issue. The concept of 'scale' as an analytical framework incorporates fundamental archaeological tasks such as collection, interpretation, and classification (James & Scott, 2004). The scale is used as an analytical framework that classifies the larger settlements into different units (details in chapter 7).

There are a variety of settlements and urban forms existing across the world, both in present and ancient times. The consensus is that all cities share a number of traits that include socio-economic characteristics, organizational units, and functional roles. However, discovering the particularly common underlying processes that generate these regularities is critical in examining the urban system or infrastructure of a region. Economics, sociology, anthropology, and archaeology insist that population is an important determinant to trace socio-economic features of settlements (Fletcher, 1995; Johnson & Earle, 1987). That approach derives the relationship between urban scale, economic productivity, and infrastructural needs (Glaeser, et al., 2003). The relationships are known as scaling relations, while a systematic study is known as urban scaling (Chave & Levin, 2003).

In recent years, settlement scaling theory developed to discuss the social, spatial, and infrastructural properties of the settlements (Bettencourt, 2013). In particular, this theory drives the relationship between a settled area and its population from a consideration of interplay between infrastructural and social networks (Ortman, et al., 2014). That regularity promotes the increased rate of social interaction and enhances the socio-economic growth, including those related to size and organization (Ortman, et al., 2014)

The settlement scaling theory is useful to examine more than one element of social organisation and can determine the socio-economic rate of interaction. This theory suggests the relationship of consumers and producers is based on population size (Ortman, et al., 2015). The fundamental process of this theory is the concentration of social, economic, and political interaction in space and time, subject to constraints imposed by environmental conditions, institutions, and technology (Bettencourt, 2013). The settlements can be proposed as social networks embedded in spaces in which people interact frequently. From this general phenomenon, we can obtain an average scaling relation between settlement size and its population.

This settlement scaling approach has been used to trace the regularities between ancient settlements and the contemporary cities and suggests a highly valuable framework to analyse the scales of the cities (Bettencourt, 2013; Ortman, et al., 2014; Lobo, et al., 2019). Settlements from Pre-Hispanic central Mexico have been studied using settlement scaling theory, and results suggest that the fundamental processes behind contemporary urban scaling operated in the ancient world just as they do today (Ortman, et al., 2014).

I have taken inspiration from settlement scaling theory as a quantitative explanatory framework to examine the larger settlements that constitute urban infrastructure around 2600–1900 BCE. The total aggregate of urban scale is determined by the urban function in terms of socio-economic output, settlement size, density, population, and location. In the present study based on these agglomerations, four different scales named A, B, C and D are developed. The largest known Indus urban settlements are analysed according to these scales and major variabilities are discussed (for details see chapter 7).

2.1.3 Urbanism and Environment

The topic of urbanism is a versatile, multifaceted and highly variable subject with a long history of research and candid debate (Childe, 1950; Weber, 1958; Lynch, 1960; Trigger, 1972; Potter, 1985). Different disciplines such as sociology, history, architecture, and planning have contributed to a deep and continuous discussion for archaeologists' interest, with contributions from Weber, Childe, Mumford, Wheatly, and Cowgill (Childe, 1935; Weber, 1958; Mumford, 1961; Whaeatley, 1972; Cowgill, 2004).

Some scholars suggest urbanism is an experience by human practices. Louis Wirth (1938) defined urbanism as 'a way of life' (Wirth, 1938). He suggested that relatively large, dense, permanent settlements of socially heterogonous individuals are urban. Cities are also considered as the physical locus of capitalist domination (Castells, 1977). Another frequently used definition of urbanization is 'the growth of urban (i.e., non-agrarian) buildings and activities' (Christopherson, 2015). Yet another popular approach is to examine cities from a functional perspective, which explores cities as central places that provide services to the surrounding hinterland (Trigger, 1972; Fox, 1977).

In archaeology, the most dominate concepts about urbanism were introduced by Gordon Childe, who coherently addressed the concept of 'city' in ancient complex societies. He argued that several interlinked factors such as political ideology, density, labour division, administration, and writing in ancient societies directed the society towards urban processes and development (Childe, 1935). He described the process of urbanism as a transition from hunter-gatherer communities to agrarian societies and industrialization. He summarized the urban process of ancient cities into 10 major elements of internal specialization, described below (Childe, 1950).

1. Settlements must be extensive and more densely populated than previous stages
2. Cities must be functionally active for specialised craftsmen, transport, workers, merchants, officials, and priests
3. Each primary producer paid over the tiny surplus he could wring from the soil with his still very limited technical equipment as tithe or tax to an imaginary deity or a divine king who thus concentrated the surplus
4. Evidence of monumental buildings distinguished from villages and also symbolising the concentration of the social surplus
5. Priests civil and military leaders and officials absorbed a major share of the concentrated surplus and thus formed a "ruling class"
6. Writing
7. The elaboration of exact and predictive sciences – arithmetic, geometry, and astronomy
8. Conceptualized and sophisticated styles of art
9. Regular "foreign" trade over quite long distances
10. A state organisation based now on residence rather than kinship

Furthermore, Childe suggested that the residential changes caused social reorientation to adjust from a small to large, large to larger, more complex socially heterogeneous urban centers. Childe's scheme provides a valuable account to comprehend the complexity of the archaeological settlements. Childe's ten points are based on the settlements from the Mesopotamia region; however, the urban settlements from several other regions of the world do not exhibit Childe's above mentioned ten points. Rather, they exhibit fewer components, such as most of the urban settlements from the Indus region do not exhibit monumental architecture (Childe's point 4). Similarly, some of the settlements from the South America region are densely populated but do not exhibit writing (Childe's point 6). The different Environmental, Cultural, and socio-economic practices create variability among urban practices in different regions of the World. The environmental variability limits us to develop a rigid definition about settlements.

In recent years, the understanding of cities or urbanism has changed, and the urban phenomenon has been suggested as a widely diverse subject rather than a single line of definition (Smith, 2007; Smith, 2008; Smith, 2016). Urbanism is a broader and more difficult subject that cannot be expressed in 'definitions', and thus, a polythetic approach is more useful.

Smith suggested that the city or urbanism definitions are only operational tools that depend on one's goals. He also argued that multi-dimensions of settlements could provide a wide range of characteristics for better understanding of social life and society, city size and population, urban functions, the built environment, urban meaning, and urban growth. Social life and the society, the most complex of all the dimensions, includes the processes concerning life and social patterns, institutions and activities within settlements. City size and demography include the population, density, and extent of the settlement, all of which have a profound social impact (Fletcher, 1995).

As there is no single definition that coherently addresses urbanism, I am therefore inspired in the present work by Childe and Smith's conceptual framework rather than a single line of definition of a city or urban center. Particularly, the Indus urban settlements cannot be evaluated by a definitive approach because of their inconsistent sizes and the limited knowledge of these settlements. Whether an area is described as an urban center or qualifies as a city depends on the author's aim; however, a settlement is an empirical phenomenon (Smith, 2018). Therefore, utilizing the concept of settlements is preferable in order to provide a better understanding. The largest settlements of ancient Indus society are considered as empirical phenomena in the present research.

However, urban process and development is an outcome of direct human and environment interaction. The interactions between humans or the environment can drive different problems in several directions such as deforestation, extensive land use, or exploitation of natural resources for the procurement of raw material. The subject of human and environment interaction has attracted scholarly attention in recent years since urbanism is a direct outcome and a continuous threat of environment degradation (Barthel, et al., 2019). Many experts argue that cities are places for socio-economic and cultural development (Redfield & Singer, 1954). On the other hand, the city is synonymous with poverty, disease, crime, flooding, and pollution (Chaudhuri, 1990). The inexorable growth of cities by human land use triggers the local environmental conditions in the form of soil degradation, built environment, and water management. About half of the land surface of the globe has been transformed by human actions, more than half of the accessible fresh water on the earth used by humans, more atmospheric nitrogen fixed by human activities than all natural territorial sources combined, and about one quarter of the bird species have been driven to extinction (Redman, 1999).

In recent years, two broader and different schools of thought have emerged regarding Urbanism in relation to the environment. In one approach, some scholars suggested that cities are places of community and opportunities (Jacobs, 1961). Monica Smith explained cities as the places of human social experiences and a source of economy that alters the process of production, consumption, and social interactions (Smith, 2003). She suggested that humans can modify their surroundings for aesthetics and practical effects. Some analysts discuss the city as an efficient nexus for better environment and for a positive change and opportunities (Keating & Krumholz, 1999).

However, researchers from another school of thought viewed the city as a place that has a negative environmental impact and promotes the rise of poverty, malnutrition, diseases, and crime (Barthel, et al., 2019). They argued that the growing rate of urbanization has a profound impact on the earth's vegetation cover, extinction of species, and the changes in the chemical composition of the atmosphere that can contribute to the reduction of food producer communities (Crutzen, 2002). The practices of urbanism can also alter land use and subsistence strategies. Thus, the study of humans' interaction with their environment is a touched element rather than an in-depth study that addresses the present-day environmental conditions in relation to the urban process and development of Ganweriwala site.

For my research, I considered the human settlements as a product of socio-economic processes but have the tendency to impact on the environment. The impact of the environment can be in the form of deforestation, artificial canal systems, or settlements themselves induce changes in landscape.

The interactions between humans and environment are the major research field known as "Human ecology". The word environment refers to all physical, natural, living and non-living surroundings known as Ecology. The study of the environment or "Ecology" has extended to human beings' lives as part of the ecological system of planet earth (Odum, 1971).

Human ecology has enjoyed academic developments through its history dating back to the beginning of the 20th century. Several major subjects have adopted human ecology as an operational method, including sociology, geography, biology, family cohabitation, economics, social anthropology, public health, archaeology, and psychology (Bates & Tucker, 2010; Isendahl & Stump, 2019). These disciplines have different approaches in addressing humans and their position in the social, ecological, and built environments. In geography and biology, humanity is seen as the part of the natural system that is subject to adaptations to environmental conditions (Catton & Jr, 1994). Sociologists have added elements of demographic evolution, social heterogeneity, and urbanization. The most influential work is by sociologists Robert E. Park, Roderick D. McKenzie, Ernest W. Burgess, who studied the processes of the growing city of Chicago in 1925. Focused on community organization and its spatial distribution, their work emphasized the difference between ecology and human ecology by highlighting the cultural evolution in human societies (Park, et al., 1925). Importantly, their work directed several other studies that suggested the interdependence of population, environment and cultural dynamics (Hawley, 1986).

The relationship of the natural and built environment is complex, diverse, and highly interdependent. Archaeological studies demonstrate that humans interacted with their environment in a multitude of ways depending on needs, culture, hobbies, and intentions. Advancing agricultural practices transformed human-environment interaction. While these activities yielded many benefits to humans, significant negative effects resulted, including soil erosion, localised but intense deforestation, disease, degradation of regional vegetative cover, and the exploitation of natural resources for the procurement of raw material (Butzer, 1982; Butzer, 1996). In the present study, the concepts from human ecology have been applied to understand the inter-relationship between culture and environment. Environment is taken as a dynamic factor that has the tendency of change. Ganweriwala settlement with a focus on the surface and spatial patterns of artefacts clustering are analysed (For detail, see chapter 4).

2.2 Settlement analysis

It is imperative to coherently address the question of the settlement patterns, urban process, and development of ancient settlements. The settlements from the ancient Indus society are heavily analysed quantitatively with a major focus on the sizes of the settlements. However, for a better understanding of settlements, we must focus on qualitative approaches. Qualitative approaches are generally flexible and provide broader understanding of empirical data. For this purpose, I selected to study a settlement known as Ganweriwala in the present research. The topography and the environment of Ganweriwala site is analysed. Furthermore, I used an attribute-based approach inspired by Smith to analyse the variabilities of settlements' scale among major Indus urban centers (Smith, 2016). These methods are briefly explained below.

2.2.1 Attribute based approach to identify the crucial dimensions of a settlement

In contrast to quantitative definitions, the qualitative studies of settlements are a better solution to focus on settlement complexity, origin, and formation process. The difficulty of defining the settlements has been argued by different archaeologists, and it has been suggested to select a cluster of variables and multiple properties (Cowgill, 2004; Smith, 2016). A flexible approach that examines different parameters or attributes of settlements can be more beneficial (Childe, 1950; Smith, 2006). There are generally two approaches to understanding settlements: 1) definitions or documentation and 2) characterization or qualitative study of typology or attributes. Definitions aid in understanding the nature of urbanism, and qualitative study or typology helps to narrow the empirical investigations (Smith, 2016). Smith suggested instead of applying a monothetic approach to define a city, a flexible approach is much better for the study of the urban expression of a settlement. This approach is known as an attribute-based approach and is used in my thesis discussed below.

The wider selection of variables, including planning the architecture ceramics layout, provides a better conception of origin and development of the settlements. These attributes can offer a better understanding of the urban form and one that is polythetic in nature (Dunnell, 1986). That means settlements can be evaluated by a series of different attributes, and urban settlements can have varying combinations of these attributes. An attribute-based approach is useful to understand the differences and similarities for the comparative study of different regions.

The attributes for analysis can be selected based on two requirements. First, each attribute must contribute to one or more theoretical discussions on urbanism. Many of these attributes are from demographic or functional definitions. The second requirement is from archaeological data that is a realistic approach to addressing the complexity of ancient urbanism.

Smith suggested 21 archaeological urban attributes by combining the work of Weber, Flannery, and Renfrew. These approaches can be used for one or more settlements to analyse the urban development and nature of urban process instead of applying a monothetic definition (Weber, 1958; Flannery, 1998; Renfrew, 2008). The attribute approach addressed the question of urban attributes and concentration on a settlement's characteristics rather than a single line definition. There are four major groups of different attributes that I used to analyse the larger Indus settlements (Smith, 2016).

Settlement size

This group comprises the physical attributes of settlements, such as the settlement size and population density. The overall size measurements and population density are analysed from five major urban centers and discussed (for more details see chapter 7).

Social impact

Palaces or temples are considered the dominant features from ancient settlements that have a social impact on the surrounding hinterland (Renfrew, 2008). Unfortunately, the Indus settlements lack these special monuments. Indus society urban centers were known as focal spaces of economic activities and appear to be unspecialized in ritual and cultural activities (Smith, 2006). As such, the town planning, architecture style, and cultural material serve as cultural markers of the urban period. Therefore, I chose architectural features and craft activities to suggest the impact on the hinterland.

Built environment

This group includes the features of the urban built environment, including planning, streets, fortifications, and civic patterns. In cases of unexcavated sites, surface surveys and mapping can determine these attributes.

Social and economic features

Smith suggested using spatial data to interpret the socio-economic features, such as cemeteries, for example. The Lower and Upper ranks of burials can determine the different ranks of the people interred there. In the case of the Indus, only the Harappa people have burials and no other settlement presents large-scale burials. I exclude this parameter in comparative discussion. Instead of cemeteries, I choose the spatial locations of the settlements to discuss the socio-economic importance.

These four groups are included in the focused four parameters for the research: the urban development, physical attributes, scaling, and the environment. Thus, discussions on settlements are at two different levels. At the primary level, the individual settlement will be addressed with a focus on urban development, physical attributes, scale, and the environment (see details in Chapter 3). At the secondary level, four different groups of attributes are analysed and compared (for details see chapter 7).

2.2.2 Settlement survey

Ganweriwala site has been examined through a surface survey, maps, and a limited set of collected artefacts. An archaeological site is the notion of an area that explains past human activities as evidenced by settlements, ceramics, pottery, or crafts. The concept of an archaeological site was adopted as a single unit of an area depicting past human activities (Willey & Philips, 1958). However, during the 1980s, archaeologists began to find an increasing difficulty in defining a site where boundaries were vague or virtually non-existent (Dunnell & Dancey, 1983). Some areas present greater densities of artefact scatters, settlements or ceramics, while others have lesser densities of detectable past human activities. To address these challenges, archaeologists adopted a flexible approach that could cover both high- and low-density areas (Terrenato, 2004). The physical limits can vary from a few meters to as many hectares. Archaeological sites can be defined based on the natural boundary, observed boundary, or arbitrary boundary. The general perception of the site boundary is as far as the spread of cultural material on the surface depicts past human activities known as the 'archaeological site' (Banning, 2012).

Ganweriwala site is observed and defined based on the artefacts scattered over the surface. However, the guess of settlement size by the estimation of artefact scatters can create errors. For example, the limits of underlying structure can be much more than calculated measurements or can be smaller than the measured site. Several cultural and environmental factors contributed to site formation can influence the actual structure, mounds and artefact scatters. Because of this, the estimation of settlement size is just an approximate value that provides preliminary results.

The settlement size and contour map is made using a global positioning system and total station. The spatial distribution and extent of artefacts is analysed by examining the density of artefacts on different parts of the settlement. Seven locations were selected from different parts of the settlements to collect artefacts by systematic controlled survey method (Details in chapter 4). The systematic surface study can be useful in formulating a hypothesis about the nature of the settlement without excavation (Redman, 1999).

2.3 Artefact analysis

The study of artefacts in archaeology is an essential tool to examine the cultural, historical, artistic and technical processes (Clark, 1968). The archaeological investigations reflect the cultural interpretations and interaction between humans, environment, and culture. The quantitative, spatial, and relational properties of the artefacts can reflect the human behaviour and social process. Schiffer discussed human behaviour as a communication that can describe the actions of the humans (Schiffer, 2002). An understanding of human social behaviours can answer the questions of how and why a society operates. Therefore, the questions to be answered regarding archaeological artefacts are:

- What are the types of artefacts from Ganweriwala settlement?
- What was the source of raw material and production techniques, such as firing temperatures, at Ganweriwala?
- How do Ganweriwala pottery production techniques compare with those of the Mohenjo Daro and the Harappa?

These questions are answered by using two types of analytical methods discussed below.

2.3.1 Type-variety analysis

I used a type-variety analysis of artefacts by Gifford (Gifford, 1960). The type-variety analysis is the morphological assessment of artefacts to analyse socio-cultural features such as art, design, and vessel type. The type-variety analysis has been previously used to study the artefact assemblage from the Mohenjo Daro and Harappa settlements (Dales & Kenoyer, 1986; Dales, 1991b). Studies suggest that the urban period artefacts present greater morphological, decorative, and stylistic similarities. The similarities are much known facts of that period and variabilities are less known. Thus, the major types of vessels, craft specialization, and decorative motifs are categorized and a list of standard types of urban period pottery established (Dales & Kenoyer, 1986). I analysed the material discovered from Ganweriwala settlement and compared it with the already established list (For more details see chapter 4).

2.3.2 SEM-EDX analysis

From last couple of decades, there are several compositional, analytical and technological methods that has been used extensively to investigate and extract reliable data from the archaeological findings (Griffiths, 1978; Bray, 1982). The application of the analytical method offers new insights into archaeological investigation to extract provenance information and rediscover manufacturing technology. Spectroscopic techniques in particular are considered useful and reliable to identify the archaeological findings and to obtain detailed knowledge and information (Eiland & Williams, 2000; Barilaro, et al., 2005). These techniques include proton-induced X-ray emission (PIXE), X-ray diffraction (XRD), X-ray fluorescence spectroscopy (XRF), polarized light microscopy (PLX), and scanning electron microscopy coupled with energy-dispersive X-ray spectroscopy (SEM-EDX) (Janssens & Greiken, 2004). These methods are used to analyse the type clay for pottery production and identifying the firing tempratures on which pottery or bricks were baked (Barone, et al., 2003).

In the present work, I have used the SEM-EDX method to analyse the mineral composition of raw clay and firing temperatures of artefacts from Ganweriwala, the Harappa, and the Mohenjo Daro. SEM-EDX is a non-destructive analytical technique that derives information through X-ray imagery. EDX is used to provide a quantitative composition of raw clay from different artefacts. The modern analytical SEM, can provide high-quality images of pottery samples and very useful to a wide range applications in archaeology. The most important use of SEM in archaeology is to study the surface morphology, body structure and firing temperature of the artefacts. The effect of tempreture on the smaples can be explained in the light of internal microstructure changes during reduction or formation.

Selected artefacts have been analysed, and thus, the results regarding production techniques at three different settlements are discussed (For details see chapter 6).

CHAPTER 3

The setting, background and regional surveys of the ancient Indus society

This chapter aims to present a general background and research history of ancient Indus society. The chapter presents environmental, cultural, and urban setting of Indus society.

3.1 Urban setting of the Indus society

2600 to 1900 BCE is a known period for the urban, socio-economic, and socio-political complexity (Possehl, 1990). During this period, Indus urban settlements were discovered from geographically more extensive regions compared to all other ancient societies (Wheeler, 1953; Possehl, 2002). An estimation is around 1000 sites were distributed over an area of 1 million km^2 during that period (Sinopli, 2015). Over this vast geographical area, there were only five largest settlements, ranging from 50 to 200 ha in size, known as Mohenjo Daro, Harappa, Dholavira, Ganweriwala, and Rakhigrahi (Mughal, 1997; Possehl, 2002; Wright, 2010). The urban period introduced a new type of community planning with a developed regional exchange network (Wright, 2010). During that period, settlements became more complex. For example, smaller settlements grew in size and became larger urban settlements, such as Harappa. Some urban centers were also deliberately planned, such as Mohenjo Daro (Jansen, 1987). The number of smaller settlements surrounded by large settlements also increased.

The urban period brought several social transformations such as the origin of writing, trade, and technology, along with much similarity and less variabilities in arts and crafts.

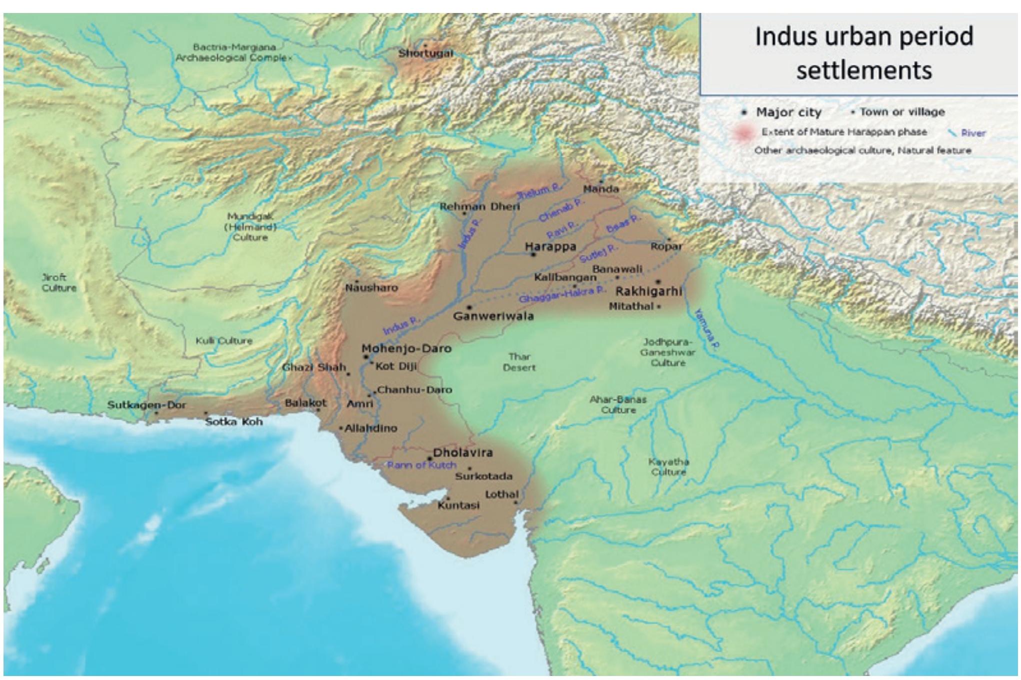


Figure 1. Five known large cities of Indus society, Map source: Wikipedia

The settlement's density is reported the highest in the Cholistan region, but several parts of other regions are unexplored, or there is a lack of published work.

3.2 The Urban processes, chronology and structural definitions of the Indus society

Urban transformation was an outcome of long-term indigenous social, cultural, environmental, and economic processes (Jarrige & Meadow, 1980; Possehl, 1990; Mughal, 1990; Kenoyer, 1998). Around 7,000 BCE, the earliest food producing rural communities and pastoral camps started to settle down at the inter-montane valleys of province Balochistan. However, regarding the origin of Indus urbanism, there are three schools of thought:

Three approaches to the origin of Indus urbanism

All of these suggestions are based on preliminary observations and indirect evidence because the earliest level of these settlements has never been excavated. In the case of Mohenjo Daro, this is because of the high water table, and in the case of Harappa, it is because of the sampling problem (Kenoyer, 2010). The empirical evidence supports that the indigenous growth of the early pastoralists and agriculturalist communities around 7000 BCE eventually led to the transition towards urbanism around 2600 BCE.

The Mehrgarh settlement is considered the earliest to the transition of urban built features. The ancient Mehrgarh is located in the Kachi Plains of the province of Baluchistan near the Bolan Pass. Discovery and excavations of Mehargarh from 1974 to 1986 added new chapters, which help to establish the origin of Indus urbanisation (Jarrige & Meadow, 1980; Jarriage, 1991). The principles of settlement planning were first introduced at the Mehrgarh around the 7th millennium BCE. The average size of the settlements was about 300 ha, which consists of six different mounds occupied at seven different periods. The settlement consists of several different houses divided into four to seven compartments or rooms. The houses were roofed with mud bricks and reeds (Kenoyer, 1998).

Around 4000 BCE, new technical skills enabled the people to colonise into Indus alluvial plains to produce more agricultural surplus and to initiate the urban processes (Agarwal, 1982). The settlement shift from small to large regions, especially from inter-montane valleys to the alluvial floodplains of the Indus River, brought several social transformations such as bronze technology and advanced town planning. Settlements from this time have been discovered on the fringes of the Indus River, from Lower Indus to Upper Indus, and on the fringes of the Ghaggar-Hakra River. Some important settlements are Kot Diji and Amri in Sindh, Rahman Dheri in Khyber Pakhtunkhwa, Kalibangan in India (on the bank of Hakra River), and Harappa in Punjab (Maisles, 2003). Kot Diji is one of the most significant settlements that developed around 4000 BCE, with a fortification wall and settlement plan.

The settlement analyses of Mehrgarh by Jarriage and Kot Diji by Mughal proposed that the development of Indus urbanism was a reaction to indigenous socio-cultural and socio-economic developments (Mughal, 1970).

However, others have suggested a sudden, rapid, even explosive urban development (Possehl, 1986; Jansen, 1987). Possehl has suggested that the changes in social stratification, craft specialisation, writing, settlement patterns, and trade relations promoted a different social ideology that directed the society towards rapid transformations within 100–150 years at about 2550 BCE (Possehl, 1990). In contrast, Mughal has suggested that the urban period of 2600–1900 BCE was a series of long-term processes that had already developed in the north and south, as discussed before. Some scholars still suggest that urbanism was an outcome of developments in Mesopotamia (Ratnagar, 1991; Ratnagar, 2001), but these suggestions cannot withstand rigorous critique, nor can they be supported by recent data (Karlovsky, 2001; Kenoyer, 2010).

Based on these discussions, there are different results or terminologies used to express the Indus chronology (Jansen, 1993; Possehl, 2002). Kenoyer developed chronology for the site of Harappa, then applied across region and creating difficulties and challenges. However, it is divided into three major periods. The most popular chronology is Early, Mature, and Late Harappa (Mughal, 1997), which gives the social evolutionary framework of birth, maturity, and decline of a society (Service, 1971). However, another popular approach to express the Indus cultural change is pre-urban (3300-2700 BCE), urban (2600-1900 BCE), and post-urban period (1900-1300 BCE) (Mughal, 1970; Allchin & Allchin, 1982; Shaffer, 1982; Kenoyer, 1989; Possehl, 1990; Wright, 2010). Later, the terms were changed into Early Harappan, Harappan, and post-Harappan by Kenoyer (Kenoyer, 1998). There is no conceptual difference between these approaches, so they can be applied according to the author's will. I have used the pre-urban, urban, and post-urban framework. The major socio-cultural changes or transformations of this framework are described below.

3.2.1 Pre-urban period

The period between 3300 to 2600 BCE, defined as the pre-urban period, refers to the diversity of regional cultures. These cultures proceeded to the urban period (Possehl, 1990). During the pre-urban period, population pressure was rising and the number of settlements were increasing. There is a record of approximately 477 settlements with an average size of 4.5 ha during the pre-urban period (Possehl, 2002). The archaeological evidence suggested the origin of craft specialisation and social differentiation during that period (Kenoyer, 1989).

3.2.2 Urban period

The period between 2600-1900 BCE is known as the urban period of Indus society. The notable transformations of this period are an increase of urban built environments, use of standardised systems, use of baked bricks, and an increase of settlement sizes. Socio-cultural and socio-economic interactions with neighbouring societies were established. The socio-cultural and economic transformations around 2500 BCE created a distinctively 'Urban' society (Possehl, 1998). Social hierarchy, craft specialisation, and production of black on red slipped vessels, shell bangles, bead making, and seals were prominent features of the urban period.

3.2.3 Post-Urban period

The post-urban period is associated with some serious socio-economic, cultural, socio-political, and environmental changes around 1900 BCE (Kenoyer, 1991). The social changes affected the settlement patterns, and a shift of settlement towards the northeastern part of Pakistan happened, so the large urban centers were abandoned. During that period, the use of square steatite seals, cubical weights, and statues of the mother goddess were also abandoned, which suggests a lack of centralised control.

Chronological scheme

The general framework of pre-urban, urban, and post-urban developed based on cultural transformations that have further subdivisions. The problem for a chronological scheme is the vast geographical region, and the chronology is based on two largely studied urban centers: Mohenjo Daro and Harappa. Shaffer has suggested a systematic chronological approach (Shaffer, 1974). He recognised regional variations of material culture and established a chronological scheme divided into four main eras. Each era represents a grouping of archaeological units that share a number of general cultural characteristics (Shaffer, 1992). These units are not confined to evolutionary stages and are not applicable for all sites. Each of these eras is subdivided into different phases. The phases present a sufficient number of characteristics that are bounded spatially and temporally in order to distinguish them from other contemporary phases (Shaffer, 1992).

Shaffer defined the four eras as:

Early food producing era (6000–4000 BCE)

This era refers to the Neolithic food producing economy that was first observed during the Mehrgarh phase. The essential traits of the Indus culture derived from this era proceed to the urban period, such as development of lapidary and shell working, use of mud bricks, chert blades, and handmade pottery.

Regionalisation era (4000–2500 BCE)

This era is divided into four major phases known as Balakot, Amri, Hakra, and Kot Diji. During this era, distinct ceramic styles, cultural styles, and complex interaction networks emerge. The era represents the emergence of cultural and social complexity within several discrete but interlinked cultural groups (Shaffer, 1992). According to new archaeological evidence, one more phase has been added to this era, known as the Ravi phase (Kenoyer & Meadow, 2000).

Integration era (2500–2000 BCE)

During this era, the localised cultural styles in the regionalised era merge into a single cultural entity, showing pronounced cultural homogeneity in almost all aspects of material culture. This era represents the largest and most elaborate form (Shaffer, 1992).

Localisation era (2100–1300 BCE)

This era represents the fragmentation of the cultural homogeneity into the development of cultural groups that persist into the Iron Age (1300–200 BCE). This era is critical and needs more work in the future.

There is no conceptual difference between the integration era and the urban period. Thus, I used pre-urban, urban, and post-urban as a general framework for this present study, as they better represent my work.

3.3 Landscape, geography, and environmental setting of the Indus society macro-region

The ancient Indus society expands on a very large geographical region that incorporates a wide diversity of physiographic features including valleys, mountains, and alluvial plains. The remains of Indus society can be traced from all parts of Pakistan, the northwestern parts of India, the northeastern part of Afghanistan, and Iran (Marshall, 1931; Wheeler, 1953; Chakrabarti, 1977; Possehl, 2002). Regional expansion encompasses several different ecological zones. To the north, sites have been discovered from Swat Valley and Kashmir Valley that are covered by a massive chain of Hindu Kush and Himalayan and Karakorum mountains. To the southwest, Balochistan (province) and the western alluvial plains of Indus are connected by two mountain ranges known as Kirthar and Suleiman, close to the Pakistan-Iran border. To the east, several settlements have been discovered within the Ganges Valley of India.

Present day Pakistan is divided into four geographical zones, as administrative units, called Punjab (northeast), Sindh (southeast), Baluchistan (southwest), and Khyber Pakhtunkhwa (northwest). Punjab and Sindh of Pakistan document the highest density of known Indus urban period settlements and are a major focus of study.

Indus settlements have been discovered on flood plains of a number of primary and secondary rivers. The major known settlements are located around two primary river systems known as, the Indus River and Ghaggar-Hakra River. The agriculture system was based on seasonal overspill of muddy waters from these rivers that renovated silty surfaces suitable for crop production. For this technical reason, the Indus people selected the flooding basins as sites for the major settlements. But some settlements such as Mohenjo Daro were deliberately planned on the bank of River Indus for better communication, and several archaeological surveys have focused on the nature and ancient routes of the Indus River for a broader understanding of settlements' correlation with water sources, as discussed below (Mughal, 1970; Mughal & Thapar, 1996).

The Indus River system was the major source of irrigation and communication (Piggott, 1950). However, the Ghaggar- Hakra is a speculative river, and there are several different theories about its nature and existence, which are discussed in 3.3.2.

3.3.1 Indus River

The Indus River is one of the world's largest rivers. It flows from Tibet and discharges into the Arabian Sea (a distance of 2900 km) (Giosan, et al., 2006). Its surrounding plains are mostly arid, as rainfall depends upon monsoons (Garzanti, et al., 2005). The water discharge was ranked as the world's 20^{th} river with 90 km^2 per year before the extensive damming started in the 1950s. However, the Indus is still one of the world's most important sediment producing rivers, building an extensive alluvial plain, delta, and the world's second largest submarine fan (Milliman & Meade, 1983). It feeds the world's largest irrigation system.

The Indus River originated from the suture zone, where the Eurasian and Indo Australian tectonic plates meet, located in southern Tibet, and deeply cuts across the western Himalayas. The western Himalayan convergence is an extreme relief with five peaks more than 8000 m high and sixty-eight peaks more than 7000 m high with ice cover (Garzanti, et al., 2005). At this stage, the Indus is not affected by monsoon rainfall, but because of summer snow melt, the sediment load increases 500 to 1000 times, and water discharge increases by 20 to 50 times. Turning to the south, the river flows to the west through the valleys of Chitral and Kohistan, which are about 950 to 1350 m above sea level (Garzanti, et al., 2005). Further down to the south, the river enters the districts of Haripur and Swabi, where the first large dam was constructed on it in 1974, named the Tarbela Dam. Through the Tarbela Dam, the Indus enters a narrow path across the Potwar Plateau. Flowing farther south, it meets four other major river tributaries from Punjab: the Chenab River, Jehlum River, Ravi River, and Sutlej River.

These rivers originate within the southern Himalayan suture zone. At this stage, they flow southwest through the valley of Kashmir to the Siwalik Hills and the Pir Panjal mountain range. The Ravi, Chenab, and Jhelum joined each other and later joined the Sutlej and Beas. These five rivers, joined together at the location of the modern city of Attock, are locally known as Panjnad ('the land where five rivers meet'), and then they join the Indus. The division of the Punjab and Sindh provinces is, approximately, where the five water tributaries of the Indus become a single river (Kenoyer, 1991). Until that stage, the region is known as the Upper Indus Plain.

With the conjunction of the five rivers, the Indus River becomes a mighty and violent river and flows to the alluvial plains of Sindh, known as the Lower Indus. Further south, it enters the mouth of the Arabian Sea (Schuldenrein, 2000).

3.3.2 Ghaggar-Hakra River

The Ghaggar-Hakra River is the second largest river system and exhibits a higher density of Indus settlements, even greater than the Indus River's. Ghaggar-Hakra originates within the Siwalik Hills, and the present-day Ghaggar River is heavily dependent on the Siwalik Hills' rainfall for water supply (Mughal, 1970). Ghaggar-Hakra runs from northern Punjab in India; near the Walhar district Bahawalpur, it enters into the Pakistan territory called Hakra. Hakra is a dry belt of the river; however, Ghaggar is a seasonal river nowadays. There is debated research about the Ghaggar-Hakra River system. One study has suggested that throughout the Indus urban period, the Yamuna River was a major tributary of the Ghaggar-Hakra River. Thus, the Yamuna and the Sutlej were both tributaries of the Ghaggar-Hakra River system, making it a mighty river that flowed from the mountains to the sea (Misra, 1984). Misra has also suggested that Ghaggar-Hakra was as mighty as Indus. He associated it with the Sarasvati River of Rigveda, yet his assumptions were based on oral traditions and folklore. However, Flam postulated that Ghaggar-Hakra and Nara were seasonal streams during the Indus urban period. He disagreed with the claim that the Sutlej and the Yamuna were tributaries of a major river. He also suggested that it is not known whether the Sutlej and the Yamuna were captured at a similar time or different times, nor is it known how much time passed between them (Flam, 1999). There are three defunct sections of the river known as Ghaggar-Hakra, the Nara Channel, and the Raini Wahinda. These sections do not contain water in the present day; there are only traces of these sections. Only the Ghaggar river has seasonal flow although Hakra is a dried belt. These three sections are not connected and impede the understanding of whether they enter the Runn of Kutch or join the Indus River, and eventually enter the Arabian Sea. There is still uncertainty about the Ghaggar-Hakra river's tributaries, its courses, and the consequences that directed the drying up of the river. Future projects are needed to solve that problem.

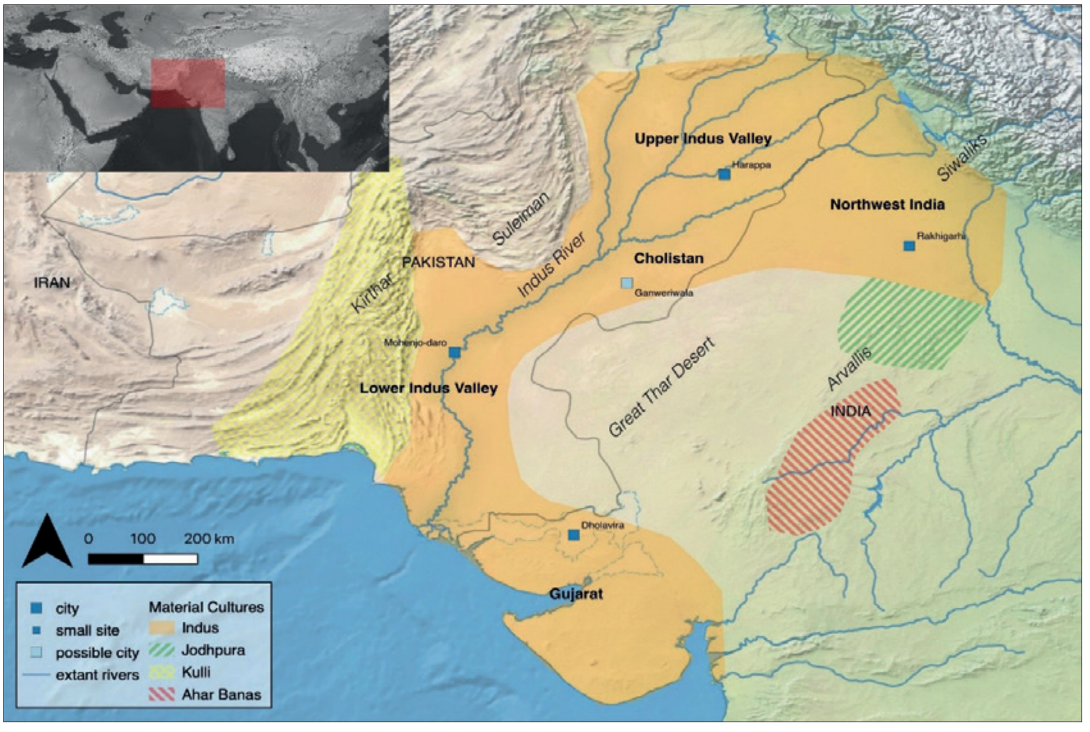


FIGURE 2. Geography of the Indus society, Map source: Courtesy Adam Green

3.3.3 Climate

The Indus region is a subject of climatic variability because of different geographical zones. The present day regional climate is dependent upon two climatic systems: one is a winter cyclone from the western highlands, and the other is a summer monsoon from the east (Snead, 1968). The variability in

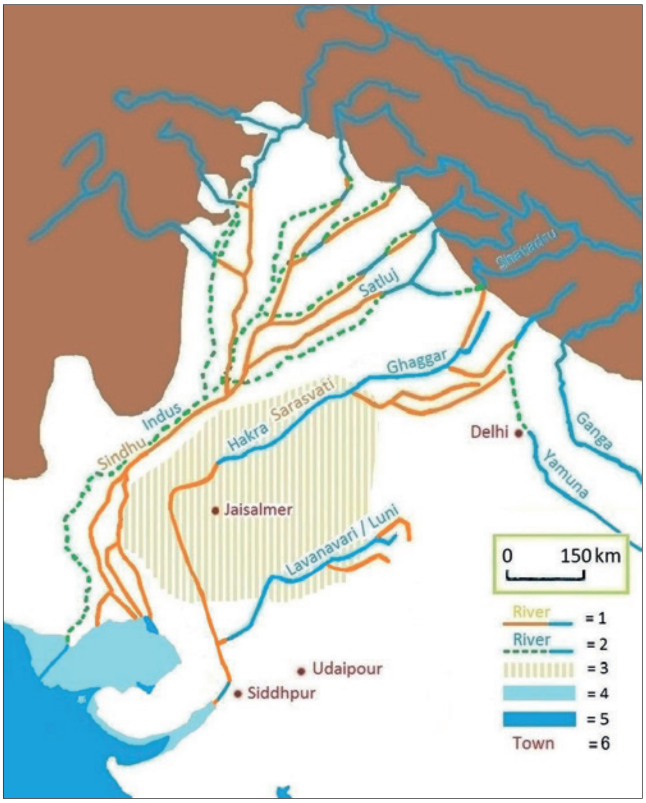


FIGURE 3. In Legend, 1 shows the orange and blue lines of the river, which means that the orange part of the river is dry and the blue part is seasonally active; 2 shows a dotted line, which means an active river; 3 shows a desert part of India and Pakistan; 4 shows a smaller course of the Indian Ocean; 5 shows the Indian Ocean; and 6 shows modern towns, Map source: Wikipedia

climate is primarily based on the changing intensities of summer and winter monsoons (Schuldenrein, 2000). Greater diversity can be seen in water availability coming from rain. Rainfall fluctuates throughout the region, varying from 50 to 600 mm/year. The regions with a higher intensity of rainfall are subject to annual flooding that causes a devastating impact on the environment. The temperature also fluctuates from below the freezing point in the northern regions to approximately 38° Celsius in the southern regions such as Cholistan and Sindh.

The shift of the monsoon wind pattern divides the year into a rainy period and a predominantly dry period. Because of this climatic pattern, hot and dry are the two dominant seasons. April to October is the hot and wet season, and November to March is the cold and dry season.

During the summer, temperatures can reach, at maximum peak, an average of 46°C and sometimes up to 50° C. The monsoons cause a seasonal reversal of wind direction and are crucial for regional subsistence. A low pressure heat drives moisture-laden winds from the ocean and brings heat and humidity to the region. During April, May, and June, the landmass begins to heat up, which causes monsoon rains (Wright, 2010). These heavy rains can cause flooding and heavy water drainage to the rivers. However, the drainage capacity of the Indus is dependent upon Himalayan snowmelt and the monsoon rains. During the month of March, the discharge of the Indus fluctuates as temperature increases and snowmelt starts in northern valleys and the Himalayas. During the months of June, July, and August, snowmelt discharge combined with the flow of the monsoons increase the width of the river to 16 km in Sindh (Allchin et al., 1978). The increased water discharge and width of the Indus causes flooding to the larger areas and fills the land spilt with essential minerals for cropping.

However, the intensity of monsoons can cause dramatic effects on regional rainfall and can vary every year. For example, it has been reported that, in Gujarat, about 250 to 500 mm of rainfall can occur in a single day (Wright, 2010). Meanwhile, in another year, if the monsoon rains are less intense, the region can be subjected to a severe drought (Weber, 1990). After summer monsoons, cooler weather starts and continues until March. The winters are associated with westerly winter rains, which originate in the Mediterranean, cross the Middle East, enter through the southern coasts of Balochistan, and terminate in the northwest of the Indian subcontinent (Wright, 2010).

3.4 Landscape, geography, and the environmental setting of the Cholistan region

Cholistan is situated in southern Punjab and covers an area of 26,300 km^2. It extends to the province of Sindh, joins the Thar Desert, and enters into Indian boundaries. The Cholistan region is bordered on the north by the Sutlej River and on northwest and west by the Indus River. The region measures 483 km long from northeast to southwest and 60–290 km wide. Approximately 15,902 km^2 are purely desert out of a total area of 25,617 km^2 (Mughal, 1997).

The northwestern part is relatively flat with low sand dunes and is known as Lesser Cholistan; the southwestern part has high sand dunes and is known as Greater Cholistan. The western fringes of Cholistan are defined by the dry bed of the Hakra River known as the Hakra Depression.

Figure 4. The Cholistan desert of Pakistan, Map source (Wariss, et al., 2013).

The climate of the Cholistan is arid with an average summer temperature of 51.6°C, which drops below 0°C in winter. The average annual rainfall is only 137 mm and is very unreliable; consequently, the region suffers from frequent and severe droughts (Mughal, 1997). Despite this aridity, a large number of herds of camel, goat, cattle, and sheep can survive on desert plants, and rainwater is collected in community ponds, locally known as tobas. These freshwater ponds can only survive close to dry riverbeds. Away from dry riverbeds, the groundwater is saline, so there is no possibility for irrigation, animal husbandry, or human settlements (Possehl, 1990). Life in the Cholistan region is heavily dependent upon seasonal rainfall. During the summer, especially in years of relatively heavy monsoon rains, the Hakra riverbed becomes a rich grassland and is heavily utilised by nomads.

The archaeological evidence from the Cholistan region suggested that Ghaggar-Hakra was an active river system that irrigated the plains of Indian Punjab and South Punjab of Pakistan in ancient times. Around 3000 BCE, some climatic changes caused the dry up of the river (Wright, 2010; Petrie, et al., 2017).

3.5 Background to the archaeological explorations on Indus region

3.5.1 Discovery and earlier excavations

The remains of the Indus society were dramatically reported in 1826 by Charles Masson. Charles Masson was a deserter from the British Army of Bengal. He visited the ruins of Harappa and confused them with the city of Sangala, which was conquered by Alexander. Later, the accounts by Masson took the attention of Sir Alexander Cunningham, the first director-general of the Archaeological Survey of India. In 1875, he reported a Seal with the bull symbol discovered from the Harappa. He reported the Harappa mounds located in a 4 km area and 12 to 18 meters of height (Cunningham, 1875). In 1922, during a railway construction project from Lahore to Multan by British engineers, the Harappa mounds caught attention because of its bricks. Unfortunately, a large part of the Harappa settlement was exploited as a source for tiles for the construction of the railway line. However, the archaeological discoveries during the railway project attracted the attention of archaeologists worldwide and the ancient city of Harappa became known. In 1924, the settlements were announced as a part of the 'Lost Civilisation' (Marshall, 1931). Soon after the discovery of Harappa, subsequent excavations started at Mohenjo Daro in 1925, led by Sir John Marshall. The results of the initial work led him to create a five-year grand project from 1926 to 1931. During the excavations, mainly held in Mohenjo Daro but also in Harappa, the first pictures of both cities were synthesised by John Marshall but later discussed in text by Gordon Childe and Mackay (Possehl, 2002). John Marshall was a classical archaeologist, and Mackay was an expert of fieldwork with prior experience from Mesopotamia.

Sir John Marshall had previously used traditional knowledge about the Indian subcontinent to make an ethnographic comparison of cultural practices from Indus society to the present. He also proposed that the Indus civilisation related to Sumer and proto-Elamites, arguing that the geographical closeness made such a suggestion possible. The *Indo-Sumerian civilisation* was the suggested name for the society (Marshall, 1931; Mackay, 1938).

From 1935 to 1936, W. Norman Brown, a professor from the University of Pennsylvania, officially received a permit to work on Indus society sites. He hired Mackay as field director to start an excavation at the Chanhu Daro site located 130 km south of Mohenjo Daro. The excavations brought significant results from bead-making and seal-making workshops.

Sir Mortimer Wheeler, in 1944, took command of the archaeological survey of India. He laid out a series of test excavations and established training schools at Taxila (1944-1945), Arikamedu (1945), Harappa (1946), and Brahmagiri and Chandravalli (1947) (Possehl, 2002).

According to Wheeler´s interpretations, *citadel* mounds were more significant elements to socio-political structure. He wrote about it, saying the following: 'It can no longer be doubted that whatever the source of their authority and dominant religious elements may fairly be assumed. The lords of Harappa administered their city in a fashion not remote from that of the priest-kings or governors of Sumer and Akkad. In other words, the social structure of Harappa conformed in principle with that of the other great riverine civilisations of the day' (Wheeler, 1946).

Piggott followed this narration and explained Indus civilisation as follows: 'A state ruled by king priests autocratic and had two main seats for power hold'. He also described Mohenjo Daro and Harappa as twin capitals. The problem of envisioning citadels at Mohenjo Daro and Harappa remains unsettled. The concept dropped off in 1953, and new approaches have since emerged (Possehl, 2002).

The earliest syntheses by Marshall, Wheeler, and Piggott gave us different interesting interpretations. Marshall has given insights about trade commerce and shared ideology. Wheeler and Piggott concluded that the temple complexes served king priests and thus were vital to early state structures, an argument which is still frequently used.

The next round of explorations came after the partition of the South Asian subcontinent. India and Pakistan became two individual and formulated independent political entities. The two large urban sites, Mohenjo Daro and Harappa, came under the geographical region of Pakistan. Archaeologists became more active with explorations in India, and the first project addressing the discussion of settlements was led by S. R. Rao in Gujarat, resulting in the discovery of Rangpur and Lothal. His explorations provide a wider framework of the Protohistoric period. The work was continued by J. P. Joshi´s excavations in Kutch and R. S. Bisht at Dholavira.

In 1955, F. A. Khan initiated exploration projects at Kot Diji and Sarai Khola under the Pakistan Department of Archaeology in Pakistan. This project concluded with significant results on the origin and development of the Early Harappan or pre-urban period and the urban period.

In 1974, M. R. Mughal conducted four-season fieldwork in the Cholistan region and presented his vision of settlement hierarchy in the Cholistan region. From 1980 till the present, there have been several projects led by local and foreign archaeologists such as J. F Jarriage's[1] work on the Mehrgarh site, which presents the earliest urban features of Indus settlements. Michael Jansen worked on the urban attributes from the Mohenjo Daro settlement. J. M. Kenoyer's work[2] provoked discussion about socio-economic matters, especially craft production such as shell work, bead making, and seal production on the Harappa settlement. Rita Wright has initiated research towards the landscape and rural-urban settlement system of the Indus society.

Currently, some French archaeologists are involved in recent research on the craft activities of the Chanhu Daro settlement. Some British archaeologists are involved in research on climate patterns, subsistence, and settlements (Petrie, et al., 2017).

3.5.2 A brief history of archaeological surveys of Indus macro-region

The archaeological record of ancient settlement networks, regional settlement patterns, and hierarchies infer the processes related to the urban form, growth, and development. The specific form of settlement patterns, such as hierarchical divisions of settlements, related to the emergence of state-level complexity were extensively studied in the 1980s within ancient Indus and Mesopotamia (Adams, 1966; Mughal, 1990). Settlement patterns also inform about social change, population pressure, urban processes, and organisation of agricultural practices and socio-economic integration of regions (Adams, 1981). In the Indus region, there is limited work at the regional scale or discussion on hierarchical settlement patterns (Mughal, 1990).

The tradition of regional surveys of the Indus plains started in the beginning of the mid 20th century (Stein, 1931). The earlier efforts were concerned with the construction of cultural chronologies and the evolutionary framework of regional and cultural developments related to urbanism, as discussed in Chapter 3. A limited number of regional surveys have explicitly explained the nature of settlement distribution (Shaffer, 1978; Mughal, 1990; Mughal, 1997). However, most of the surveys are explorative works with traditional methods and details about the origin, extent, and socio-cultural features of settlements still lacking.

Flam surveyed the southwestern region of the Sindh province and used an ecologically determined approach to study settlements (Flam, 1981). His studies concluded that complex, diverse agricultural

1 For details see Jarriage et al 1995

2 See details Kenoyer 1998

strategies and raw material exploitation caused the settlements' distribution. He roughly recorded 72 settlements of the pre-urban and urban periods, but settlement hierarchies are not discussed.

One of the most significant and large-scale regional surveys was conducted from 1974–1977 by Mughal, the former director-general of the Department of Archaeology, Pakistan, on the southern region of Punjab known as Cholistan (Mughal, 1997). The Cholistan regional survey documented approximately 174 settlements of all periods of Indus culture. The general aim of the survey was recording, documentation, and surface collection of the archaeological sites. The settlements were analysed based on their size at that time, and surface artefacts were collected and analysed.

During 1993–1995, several large-scale surveys were conducted in Punjab and Sindh by the Department of Archaeology, Pakistan. Seventeen different districts of Punjab were explored, and 91 archaeological sites of Indus culture around pre-urban, urban, and post-urban periods were recorded. From these, 28 were associated with the urban period. Upper Sindh, including the districts of Sukkur, Khairpur, Shikarpur, and Jacobabad, have been explored and 35 sites of Indus culture were recorded, from which 27 were associated with the urban period. The details of the results of these surveys are written below.

Another important survey conducted by the Punjab Archaeology Department team, in a collaboration project with Rita Wright, is known as the Beas regional survey. The aim of the survey was to revisit the area around old Beas River and record Indus society settlements to reconstruct the landscape and environment (Wright, et al., 2008). All of these surveys produced massive amounts of information and material culture that is rarely analysed by in-depth studies.

3.6 Background to the archaeological explorations on Ghaggar-Hakra River system

Ghaggar-Hakra is the second largest river system that presents Indus culture settlements. The explorations around the Ghaggar-Hakra plains started in 1916, but reports were never published although Mughal mentioned these reports in his book and concluded that the Ghaggar-Hakra plains of India and Pakistan have the richest evidence of archaeological settlements. Mughal discussed that Italian Indologist, Tessitori (in charge of folklore and historical surveys of Rajputana), recorded a number of ancient sites and monuments in Bikaner in northern Rajasthan between 1916 and 1918. The document has 44 pages of rough notes but was never published. He conducted some small-scale excavations on Early Historic and Protohistoric mounds and connected them with the Early Historic necropolis of the Johiyas, the descendants of the ancient Uaudheyas. This region has been investigated several times from 1916 until 1976, but published reports and long-term projects are limited. The most extensive study around the Hakra River plains was by Mughal during his field project from 1972 to 1976, as discussed in Chapter 4. Below is a brief history of regional explorations.

Aurel Stein explored the Ghaggar-Hakra plains. He visited the roughly 418 km long region in the former states of Bikaner and Bahawalpur in 1940 and 1941. In the Bahawalpur region, he located sites between Fort Abbas and Derawar Fort. He wrote a report on his work entitled *An Archaeological Tour along the Ghaggar-Hakra River, 1940-1942* (Stein, 1943). It was not a comprehensive report, but it was the only summary of his findings that was published.

Henry Field visited the region explored by Stein, which is from Dera Nawab Sahab to Derawar, and then eastwards to Fort Abbas up to the Indian border (In 1955, the manuscript of Stein´s report was microfilmed by Henry Field at New Delhi and placed in the Library of Congress Washington D.C. The manuscript has no maps, drawings, photographs, or other illustrations).

A. Gosh assisted by Krishna Deva (1953) surveyed northern Bikaner. They recorded more than 100 sites, but a full report was not published either. Hanna Rydh, the Swedish archaeologist, started excavations at the Rang Mahal site near Suratgarh in 1952, which is associated as an Early Historic period settlement.

In 1960, B. B. Lal and B. K. Thapar started excavations at certain settlements around the bank of the Ghaggar River, such as at Kalibangan, an Indus urban settlement of 11.5 ha in size. Suraj Bhan also had test pits dug at Siswal and Mitathal (Bhan, 1972; Bhan, 1975). In 1963, K. N. Dikshit (1967) visited the old channel of the Sutlej, which is considered to be a dried channel of the Ghaggar, and reported several sites around its banks. In 1965-66, Feroze Dalal (1980) examined 17 sites on the Ghaggar River. In 1977, Suraj Bhan and Jim G. Shaffer explored the region (Shaffer, 1980).

The Ghaggar River enters Pakistan and is locally known as the Hakra River, southwest of the Derawar Fort. This part of the river system remained unexplored until a comprehensive programme launched in 1972 by the Archaeological Department of Pakistan began under the direction of Mughal. A closer reading of Mughal's work on the Cholistan region is presented in Chapter 4.

The archaeological explorations along the dry bed of the Ghaggar-Hakra have resulted in the discovery of 414 ancient sites, mostly associated with Indus society culture. The high intensity of Indus settlements at that region suggests that it was a principal region for urban process and development. For this reason, the Cholistan region has been termed the 'bread basket' of Indus society (Possehl, 2002).

The research project by Mughal in the Cholistan region suggested that the region was strategically a good place for agriculture, pastoralism, and trade (Mughal, 1997). Extensive archaeological material and its cultural association with Indus society culture have attracted scholarly attention. Mughal's four-season fieldwork is a major contribution. His survey was based on traditional methods, and the major aim was the documentation of archaeological sites.

3.7 Settlement patterns of Punjab

The province of Punjab in Pakistan has five main water sources, which are known as the Sutlej River, Ravi River, Beas River, Chenab River, and Jhelum River. These five rivers confluence at the Bahawalpur District and run southwest approximately 45 miles to join the Indus at Mithankot. The floodplains of these rivers provide a suitable environment for human and animal existence and have great potential for food production and grazing. This province has potentially numerous archaeological settlements and has been surveyed by the Punjab Archaeology Department, Pakistan. The region is divided into two major zones by previous surveyors: the north region is known as Upper Punjab, and the south region is known as Lower Punjab. Both regions have been surveyed and hundreds of settlements have been documented.

However, the archaeological remains of the southern Punjab (Lower) are well documented and present the highest settlement density compared to any other region. The southeastern region of Pakistan mainly consists of desert with the dried belt of the Hakra. It is assumed that during the 3rd millennium BCE, the region was a part of the active Ghaggar-Hakra system, but around 1500-1000 BCE, its principal tributary, the Chautang, dried up completely (Mughal, 1997). The largest known settlement of that region is Ganweriwala site. But in northern Punjab (Upper), there is limited work. The largest site in the Upper Punjab is the Harappa, which is situated on the dry bank of the Ravi. The settlement density of that region is much lower than Lower Punjab. The summaries of southern and northern Punjab are discussed below.

Mughal did village to village survey to examine the archaeological remains along the Bahawalnagar District and extended it towards the southwest across three districts. The surveyed region covered a total area of over 483 km, as covered while driving a jeep. The aim was to document archaeological sites on both sides of a 24–32 km wide strip of dry bed of the Hakra River in the Cholistan region. The survey followed traditional methods by walking around, examining pottery, map making, and measuring using an imperial tape. The project lasted for 4 seasonal years. The survey resulted in the recording of hundreds of settlements, settlement sizes being measured, a chronology being established based on the artefacts. The changing of settlement patterns from subsequent periods from 3500 until 1600 AD were recorded.

The survey resulted in a total 414 sites associated with the pre-urban (3500 BCE) to the Historic (400 BCE) and Medieval period (1600 AD). Among these sites, 174 belong to the urban period which was the largest in quantity of the proceeding periods.

During the urban period, the total agglomeration of settlements spread over an area of 447.68 ha (Mughal, 1997). The concentration of the urban period settlements is greater around the west of the Derawar Fort than in any other part of the region. The settlements extending to the Rahim District were not found beyond this district. Mughal defined the settlements according to their sizes and adopted a five-tiered hierarchy approach: campsite, a small village, large village, small town, large town, and city (for details, see 4.4).

One of the significant features of urban period settlements from the Cholistan region is the evidence of purely industrial settlements. After analysing several settlements, Mughal proposed evidence for a rare type of settlement in that region determined to be industrial settlements. He referred to these settlements as exclusively used for the large-scale production of standardised products, such as fired bricks, pottery production, and metallurgical activities. Industrial settlements also present social stratification and trade with other settlements. Of the total number, 79 settlements belong to the industrial settlement group, and an additional 33 settlements represent some specialised craft activities. Two settlements are suggested as being cemetery settlements. Thus, the region represents the highest number of fired-brick industry settlements compared to any other region.

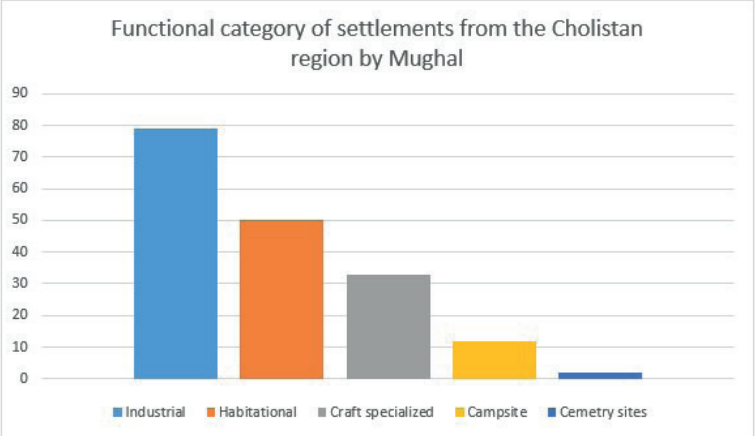


FIGURE 5. Functional category of the Cholistan regional settlements by Mughal

The other significant result from the Cholistan regional survey is Ganweriwala site. Ganweriwala site has two closely situated mounds measuring 503 x 533 m (1650 x 1750 ft) and 488 x 290 m (1600 x 950 ft) with an average height of 8.5 m (28 ft). Mughal suggested that both mounds measured together are 81.5 ha. The size of Ganweriwala is described as comparable to Mohenjo Daro, which is approximately 16 ha less. The total area of Mohenjo Daro's city and the citadel, including the open spaces, is 97.1 ha. Otherwise, the area covered by the ancient remains of Mohenjo Daro is 83 ha. The other major settlement of Harappa is about 65 ha, excluding the H and R-37 cemeteries, which is 16 ha smaller than Ganweriwala (see details in Chapter 5).

The number of settlements and their sizes are mentioned in the below chart.

Small village	Large village	Small town	Large town	City
0.1–5 ha	5.1–10 ha	10.1–20 ha	20.1–30 ha	80+
44	20	8	0	1

Table 1. The Cholistan regional survey of urban period sites

The settlement number of the preceding periods (1900–1500 BCE) declined with only 50 settlements, and during 1100–500 BCE, only 14 settlements. The decrease in the settlement number suggests that some serious climatic, socio-cultural, or economic changes happened that made them not suitable for human habitation.

The archaeological investigations in northwestern India (Ghaggar survey) reported that 218 sites belong to the urban period. The well-known settlements of the region are Rakhigarhi, Banawali, and Kalibangan (Possehl, 2002). Thus, the total number of settlements around the bank of the Ghaggar-Hakra River plains is 410. Among the 410 sites, the two largest are Ganweriwala and Rakhigarhi.

The Upper or north Punjab region was surveyed by Wright in order to reconstruct the settlement patterns, environment, and landscape (Wright, et al., 2008). The survey was conducted in the surroundings of the Harappa settlement around the old banks of the Beas River.

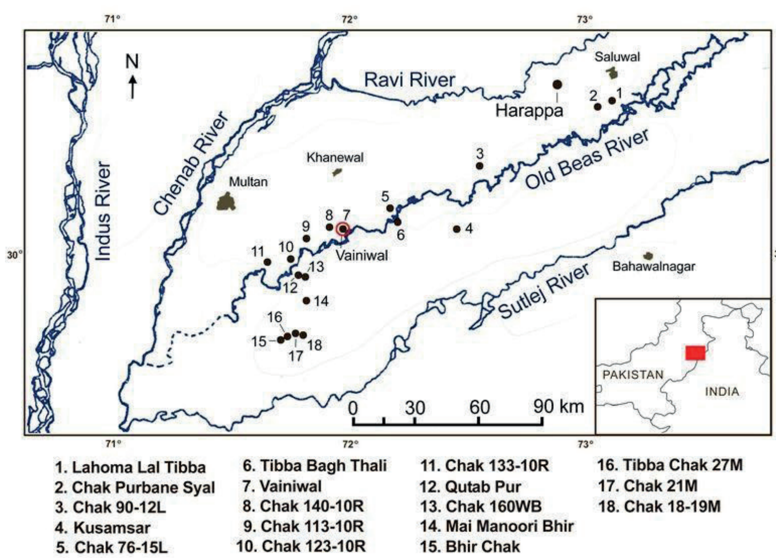


Figure 6. Settlements around Old Beas River, Map source: (Wright, et al., 2008)

The survey results show more settled areas around the old Beas River than Ravi or Chenab. There are a total of 18 settlements around the old Beas. The settlements are of various sizes, ranging from small villages, large villages, small towns, and large towns to cities. Most of the settlements are less than 30 ha. Harappa is the largest settlement in the region. The settlement patterns around Harappa suggest that the smaller settlements played a vital role for the development of Harappa as an urban center.

Small village	**Large village**	**Small town**	**Large town**	**City**
0.1–5 ha	5.1–10 ha	10.1–20 ha	31+ ha	80+ ha
9	7	1	0	1

Table 2. The Beas regional survey of urban sites

In Punjab and around the Ghaggar-Hakra River plains, a total of 410 settlements have been recorded. The Ghaggar plains have the highest intensity, while Beas presents the lowest intensity of settlements.

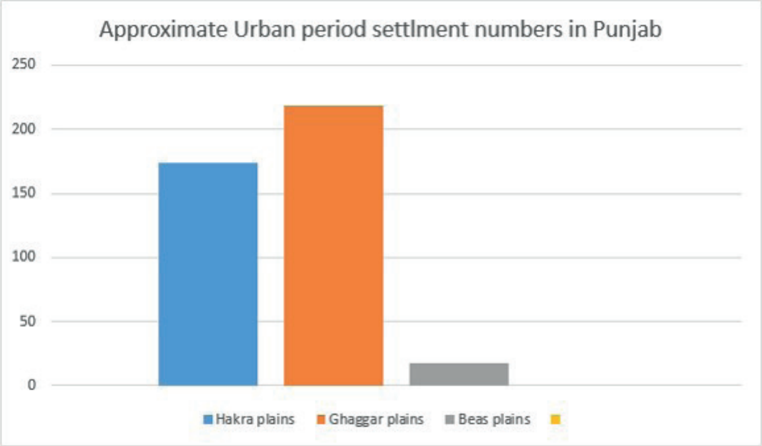


Figure 7. Urban period settlements in Punjab

3.7.1 Archaeological evidence from the northeast Punjab, Pakistan

The northeast of Punjab has a great potential for archaeological discoveries. This part is specifically significant because around 1900 BCE a settlement shift happened towards that part. The northwest region of India is well explored, but in Pakistan there is limited work on that part. The archaeological investigations on that region can produce very important results. There are hundreds of unprotected archaeological sites. Unfortunately, they are the victims of negligence and have not even been recorded. The region was surveyed by Mughal in his 1992 to 1996 project to record the ancient settlements. Most of the settlements had fallen victim to modern construction and graveyards; however, a number of settlements from this part belong to the 2nd century AD to the 19th century (Mughal, 1997). From the Sialkot District of the northeastern Punjab region, he discovered a few settlements from the 2nd century BCE to the 8th century AD. That emphasises the importance of the region.

Sialkot City is situated in northeastern Punjab (also called Upper Punjab) with geographical coordinates of 32° 30’ 0’ north by 74° 31’ 0’ east. Sialkot is located in the foothills of the Himalayas situated on the Piedmont terrace. It is bounded on the north by Gujrat; Jammu on the east; in the south, by Gurdaspur and Amritsar, respectively (India); and on the west, by Sheikhupura and Gujranwala. The tract is irregular in shape with a length of 99 km and a breadth of 74 km, lying in the Rachna Doab between the Chenab on the north and the Ravi on the south. The total area of Sialkot is about 2,499 km^2.

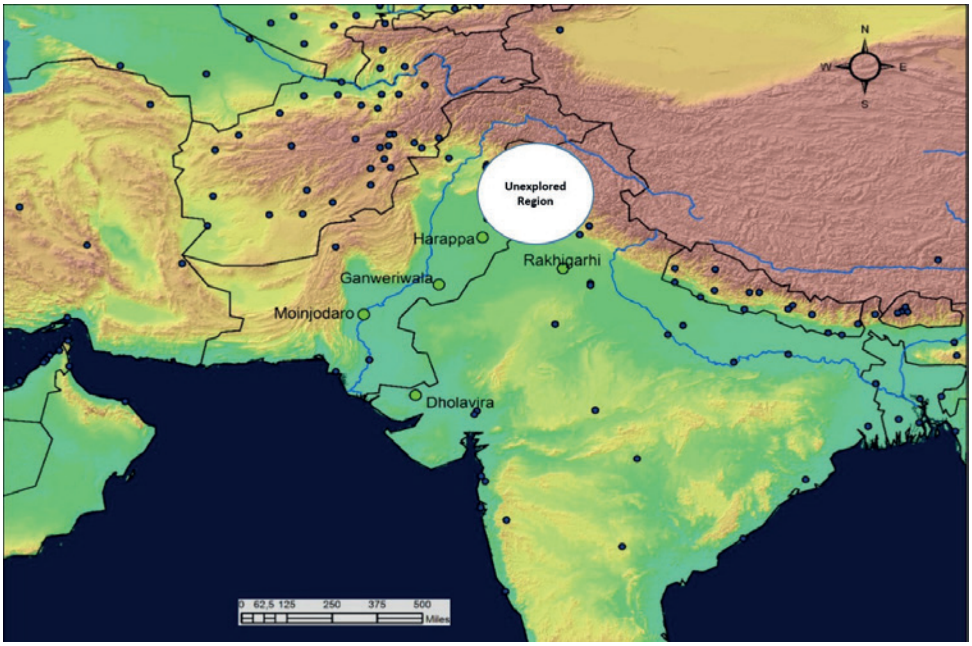


Figure 8. Unexplored region of the Indus Society

Figure 9. Location of Sialkot, Map source: Wikipedia

In 2010, I surveyed Sialkot City and the surrounding villages to re-investigate these settlements. I did village to village pedestrian survey of different settlements, took photographs and data description recorded manually. The central part of the city was slightly higher than its surroundings, but the modern construction and density did not allow for the investigations. I surveyed surrounding villages. We could not examine all the settlements described by Mughal, but we recorded one significant archaeological site that presents a long history of occupation on exposed stratigraphy. The village Zahura is about 14 km northeast of Sialkot. The modern village is built upon an ancient mound that is several metres higher than the ground plain. The exposed parts of the mound present interesting archaeological material of the Historic period related to Indus culture. The stratigraphy presents several cultural layers and traces of baked bricks. Systematic surveys of these mounds of Upper Punjab can produce significant results for understanding the dynamics of settlement shift. However, the suggested results need to be verified with systematic studies in the future.

Archaeological material from Village Zahura

Figure 10. Brick remains at the Zahura mound, Sialkot

Figure 11. Densely covered surface with artefacts

Figure 12. Remains of bricks on the Zahura mound, Sialkot

Figure 13. Cultural layers at the Zahura mound

The exposed part of the mound suggests at least five cultural layers. Tvhe Upper layer suggests a Historical period occupation, but the later layers and material need to be investigated for further details.

3.8 Settlement patterns of Sindh

The province of Sindh is situated in southern Pakistan. Toward the west, Sindh is followed by the Kirthar piedmont, and towards east, there is an extension of the Cholistan Desert called the Thar Desert. Sindh has become very popular for archaeological investigations since the discovery of Mohenjo Daro. The explorative surveys were started by Majumdar during the winter of 1927–28 in search of additional settlements affiliated with Mohenjo Daro. He carried out explorations, and a narrative of his explorations was published (Majumdar, 1934). He explored the Kirthar piedmont and the Sindh Kohistan region, and he recorded 37 prehistoric settlements. His investigations provided the base for further investigations, and several significant settlements were discovered, such as Kot Diji and Naro waro Daro discovered by Ghurye in 1936, Mackay excavated Chanhu Daro in 1943, Mughal excavated at Jhukar, and Casal excavated at Amri in 1964.

Sindh is largely surveyed, but most of the reports are unpublished. Some parts of the province of Sindh or the Lower Indus region were surveyed by the Sindh Archaeological Project (Flam, 1993). Flam recorded three types of settlement systems that existed at Sindh, which are known as Amri culture settlements, Kot Diji culture settlements, and the urban period settlements. The settlement systems vary characteristically. The Amri settlement system is confined to the mountain valley and Kirthar piedmont region. The Kot Diji settlement system spread to the desert of the Cholistan piedmont of Kirthar, Sindh. The outgrowth of Amri and Kot Digi settlements is considered the platform of urbanisation. The Harappan, or urban period, settlements adopted a riverine ecosystem and developed on the Lower Indus basin and in the Cholistan region. The density of the settlements in the Lower Indus basin was not high. However, they were located at optimal locations, which were close to water for agriculture production. Individual settlements were self-sufficient for agriculture production. The settlements were not defensive.

Thar desert and Khairpur, Sukkhar District, were extensively surveyed by the Shah Abdul Latif University, Khairpur, Sindh, but reports are unpublished.

The Khairpur University team reported 65 settlements of the urban period in the Lower Indus region, and Lakhenjo Daro is the largest site among them, but the sizes of the settlements have not been reported. Recent studies about Thar desert present a three-tiered hierarchy in settlements. Among them, there are at least three towns and others are villages and campsites, but the sizes of the settlements have not been reported (Mallah & Rajpoot, 2016).

3.9 Background of Indus urban studies

The urban centers of Indus society have been studied to find socio-political authorities or socio-economic models (Kenoyer, 1997; Possehl, 1998). However, Indus urban centers have a lack of structural or typological studies (Trigger, 2003; Yoffee, 2005). Several Indus urban settlements are less known for their precise sizes, symbolic, or monumental architecture, and socio-political authorities. Limited scale excavations, old reports, and chronological problems strictly limit our understanding of urban processes around 2600–1900 BCE. Several geographical parts exhibit limited archaeological investigations due to modern land use and human occupation. The results of many surveys and investigations are not published. Among several contributing factors related to the lack of research on the communities of Indus society is temporal lag, which is one significant factor. These difficulties limit the understanding of settlement scales, and the urban infrastructure of Indus society during 2600-1900 BCE was during a period of major social transformations.

Indus society has enjoyed research since the 1920s, but it still lacks solid terminologies. Research has focused mainly on limited elements concerned with the generation of cultural chronologies, technological and material studies, trade, and regional settlement patterns (Marshall, 1931; Mackay, 1937; Wheeler, 1946; Piggott, 1950; Kenoyer, 1997; Mughal, 1997). Day by day, changing research dynamics affect the general interpretation of society, such as the ideas that Indus society has enjoyed many different titles. Examples are Indus society culture, Indus civilisation, Harappan society, Archaic state, City-state, and Complex society depending on the author´s will (Feinman, 1998). Few archaeologists have suggested that Indus urban settlements do not exhibit sufficient indicators to be construed as state-level societies compared with the Mesopotamian and Egyptian societies (Shaffer, 1982; Fairservice & Southworth, 1989). But still, the general consensus is that Indus urban settlements do reflect some form of state-level organisation (Possehl, 1990; Kenoyer, 1991). The contrasting arguments about Indus urban settlements have been reformulated many times using new and old data, but the most dominant is Indus as a state-level organisation (Kenoyer, 1994; Possehl, 2002; Wright, 2010).

However, Indus urbanism is not a new topic; rather, it has been a subject of discussion by several archaeologists from the 1920s onward (Jansen, 1984; Possehl, 1990; Kenoyer, 2000; Wright, 2010). There are few studies concerned with settlement patterns, ecological constraints, and subsistence (Flam, 1981; Mughal, 1997; Wright, 2010; Petrie, et al., 2017). The studies addressing settlement patterns and environment are limited to specific regions: Flam investigated the settlement patterns of the Sindh region; Mughal investigated the Cholistan region; and one recent project was based in the northwest region of India (Green & Petrie, 2018).

The geographically vast Indus society has proved difficult to understand, as have its socio-political and structural systems. The archaeological data does not fit the conventional models applied elsewhere. Shaffer described Indus society in this way:

'It could be that the Indus society a technologically advanced, urban, literate culture was achieved without the usually associated organisation based on hereditary elite, centralised political Government (State or empire) and warfare' (Shaffer, 1992).

The lack of monumental architecture, undeciphered script, and elite burials constitute a different type of social structure as compared with ancient Egypt or Mesopotamia. Particularly from 2600 to 1900 BCE, the period is more complex with an unknown social hierarchy.

However, certain questions related to settlements scale, socio-economy, urban processes and development are still unanswered. Most of the research is associated with socio-political models. Some studies have investigated Indus settlements for social and political organisations, but they were discussed at a very general level with a limited number of social elements (Possehl, 1998; Kenoyer, 2000; Vidale, 2010). Most archaeologists have suggested political or socio-economic models for Indus settlements in order to decide whether they were state-level societies or not (Kenoyer, 2000; Wright, 2010). Kenoyer addressed Indus society as a complex society that was politically independent but culturally unified (Kenoyer, 1997). The cultural unification can be political ideology, economic strategy, or social relations (Kenoyer, 1998). The major urban settlements are located at large distances, and each is surrounded by a vast hinterland. They share a common language in terms of cultural material and the standardisation for economic exchange. The similarity in socio-cultural elements may reflect on common ideology, but due to the large distances, it is unlikely that one ruler had full socio-political and economic control of all regions (Kenoyer, 1991).

These matters such as socio-political complexity, chronology, and socio-economy have been established by focusing on the classical type sites: Mohenjo Daro and Harappa (Jansen, 1984; Kenoyer, 1998; Kenoyer, 2008). The settlement planning architecture and water management systems of Mohenjo Daro have been intensively studied (Jansen, 1987). But, relatively little work has been done on other settlements, such as Ganweriwala. There have been few comparisons among larger settlements. One significant work regarding urban comparison was completed by Eltsov. He studied three groups of data: excerpts from Sanskrit and Pali texts, a sample of archaeological settlements from the Vedic period also known as Ganges civilization that developed around the River Ganges (1500-500 BCE), a sample of archaeological settlements from the Indus urban period (2600-1900 BCE). Excerpts from the Sanskrit and Pali texts were used to understand the idea or concept of a city in ancient India. Eltsov's study focused on the continuity of architectural elements from the Indus urban period until the Vedic period (Eltsov, 2008). The architectural attributes of several small and large-sized settlements from the Vedic period (1500-500 BCE) and Indus urban period were compared. However, his study focused on the continuity of the urban elements and lacks details about the Indus urban period.

Another study analysed Indus urban centers to support the heterarchy framework, but it lacked an explicit discussion (Smith, 2006) (For details see chapter 3). Wright discussed the five frequently quoted large urban centers using central place theory, which considers the urban centers as major nodes controlling hinterland resources (Wright, 2010).

The available research on Indus urbanism does not address the question of urban infrastructure and its environment.

3.10 Discussion and summary: Methodological problems and possibilities

The Cholistan regional survey and the Beas regional surveys are two well-known surveys that systematically studied landscape and settlement patterns. The Cholistan regional survey produced a large number of data sets that need to be revised with advanced methods.

Results from both surveys indicate that major cities were located on the alluvial plains surrounded by hinterlands to control the socio-economic activities. Wright argued the Indus society settlements present a central-place model proposed by Christaller and present that primary settlements may exist along with counterpart secondary settlements (Wright, 2010). The combination of rural and urban settlement patterns manipulates production and distribution over the vast landscape.

The different regions of Indus society present different densities, size frequencies, and settlement systems. The settlement density around the bank of the Ghaggar-Hakra River plain is greater than in any other region. Northern Punjab and the Sindh region need more work.

The settlement patterns of the province of Punjab present a five-tiered settlement hierarchy. The major urban centers were surrounded by hinterland. An approximate calculation of hinterland controlled by each larger settlement ranges from 100,000 to 170,000 km^2 (Kenoyer, 1997). The smaller settlements range from 0.1 to 20 ha, and there are no settlements between 20 to 60 ha in size around Harappa, Ganweriwala, or Rakhigarhi. In Sindh, the settlements present a three-tiered hierarchy, and the density of the settlements is lower than in the Cholistan region. However, the Amri and Kot Diji cultures of Sindh were developed to a full range urbanisation in the Cholistan region.

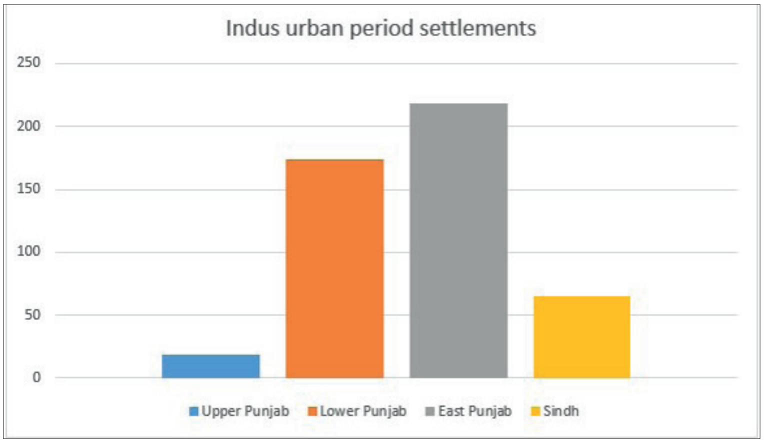


Figure 14. Indus urban period settlements

However, the methodology used to define settlements as village, town, or city has limitations, which are revised in this present work.

Mainly, two problems exist with the regional surveys and methodology. First, the surveys are very old and the material collected from the surveys is rarely examined. The second problem is the settlements' rank-size analysis. The settlement hierarchy was first developed by Mughal based on settlement size. He argued that site size and population are two important factors to defining a settlement hierarchy (Mughal, 1997). Mughal adopted McC Adams and Phillip Kohl's methodology used for the study of the southern central Asian settlements. Adam defined villages that cover an area between 0.1 to 6 ha, towns as 4.1 to 25 ha but less than 30ha, urban centers between 30 to 50 ha but less than 100 ha, and for a large city, the size should be more than 100 ha (Adams, 1966). Meanwhile, Philip Kohl defined the settlement pattern in southern central Asia into three main categories: villages are 0–5 ha, towns are 5–20 ha, and cities are more than 20 ha (Kohl, 1984). In 1984, Indus society settlements were redefined by Joshi: sizes of 4 to 16 ha are villages, 25 to 81 ha are towns, and cities would be under the size of 225 ha.

Based on these earlier investigations, the settlement size definition would be variable in different regions, which can be highly problematic. In the case of Indus society, Mughal adopted the site size category that was approximately close to Philip Kohl and Adam (Mughal, 1990).

Small village 0.1–5 ha

Large village 5.1–10ha

Small town 10.1–20ha

Large town 30 +ha

City 80+ha

The sizes of Indus settlements are highly problematic because of early destructions at Harappa, the higher water table at Mohenjo Daro, and the unexcavated Ganweriwala site. Another limitation with the hierarchy is that several smaller settlements have complex urban features, for example the Kalibangan site. It is located on the left southern bank of the Ghaggar in Rajasthan, India, and has a planned layout with an east-west orientation. The settlement plan is similar to typical Indus urban plans, such as being divided into Upper and Lower towns. Can we categorise this site as a village because of its smaller size? This is a question worthy of consideration.

Unfortunately, most of the Indus settlements lack theoretical discussion and are the subjects of quantitative discussion. Mughal established and discussed settlements in the framework of a five tiered hierarchy.

Figure 15. Settlement hierarchy of the Cholistan region by Mughal (Mughal, 1990)

The quantitative definitions of the settlements can be highly problematic and variable in different regions. The description of settlements as small village, large village, small town, large town, or city was never discussed coherently. However, most of the authors stressed upon defining cities. Smith has argued that there has been very little emphasis on the definitions of South Asian Urbanism or what are the specific features of a settlement that constitute it as being a city or urban center (Smith, 2006). Shaffer stated that the lack of basic definitions creates a situation in which developing a topic about South Asian cities is highly dependent on the reader's willingness and the author's unspecified vision (Shaffer, 1996). Another major problem is the concept of ancient cities influenced by the present-day administrative criteria rather than considering the social conditions and complexity of ancient times. For example, Misra (1991) has proposed that the earliest cities have two main characteristics: the first is increased population density in smaller spaces, and the second is emerging non-cultivating or nonagriculturist communities (Misra, 1991). Misra's definition was influenced by the modern Indian city's definition, which describes 5,000 people living in an area of 1000 per square mile, with a ratio of 75% males working in non-agriculturalist occupations (Potter, 1985).

The demographic or quantitative definition provides a hierarchy scheme of the society, but the method of quantitative definition of a city provoked debate on the error of site sizes in archaeological cases. Site size that is based on a physical boundary can cause problems. For example, site formation processes that erode or obscure deposits can diminish the actual site size (Schiffer, 1987). Another problem can be expanded into socio-cultural practices such as 'manuring' nearby fields with household refuse to produce an extensive artefact of scatter that can be mistaken for a settlement (Wilkinson, 1982).

Another limitation to this method is the lack of consensus on the central issues related to urbanism. The rank-size model describes static equilibria of spatial distributions of city sizes and cannot answer external or internal specialisations. The quantitative study does not address the socio-economic functions coherently (Smith, 2008). Moreover, this method cannot produce the correct hierarchy if settlement sizes are inaccurate. Another problem with the sizes of the cities is that there is no particular definition of towns (Smith, 2006). Recent work in Sri Lanka has demonstrated that smaller settlements have contributed to the dominant role in socio-political and economic development that emphasises that site size as an indicator can be unreliable (Coningham, et al., 2007).

Demography and settlement size are key factors to establish a site as a city or urban center (Bettencourt, 2013). Both elements are fundamental to determining the scale of a site (Smith, 2016). However, based on a single factor we cannot accept or reject a site as a city. The other problem with a size definition is the density of the built environment. For example, if we have discovered a fortified walled architecture of 200 ha, but the internal structures are less densely located on wider spaces, would we call it a city? Because of the large size, no, we cannot characterise it as a city because of minimum interactional units within spaces. This type of settlement can be defined as a political unit, temple, or religious place, but not as a city. Another limitation with the hierarchy analysis is the unexcavated settlements, for example, in the case of Ganweriwala. It was reported that the 81.7 ha large site was contemporary with Mohenjo Daro (Mughal, 1997). Later, few archaeologists objected to the earlier reports by Mughal and reported that Ganweriwala is a 42 ha site (Kenoyer, 2008; Masih, 2018). However, the geographical location and material study confirm that Ganweriwala was a major urban center of the Cholistan region (Mughal, 1997; Wright, 2010; Gulzar, 2020).

For this reasoning, the present study provides a different approach to tackle the problem of settlement hierarchy. Instead of focusing on quantitative definitions of settlements, Indus settlements should be addressed using a qualitative definition with much focus on their socio-economic and cultural attributes rather than size description. By analysing qualitative characteristics of settlements, there are certain important elements that can be discussed and can provide a better understanding, such as the use of baked bricks at the Inuds settlements.

The use of baked bricks in construction is an economic signature of the Indus society and can be critical for distinguishing among urban and rural settlements. In several cases, a mix of mud-brick and baked-brick architecture were discovered. For example, Lakhanjo Daro is an important Indus urban period settlement located almost 100 km in the south from Mohenjo Daro, which presents the architecture of baked bricks and mud bricks. Two types of construction materials signify economic differences among different socio-economic or functional parts of the settlement.

FIGURE 16. A shows a mud-brick platform, and B shows a mixture of mud-brick and baked-brick architecture

There are four types of construction materials discovered to construct Indus settlements. Three types of materials are evidenced and one is lacking because of its transformative properties. These materials are:

- Mud with a mixture of husk or cow dung for strengthening
- Mud Bricks
- Baked Bricks
- Stones

The discussion on construction materials is critical for studying the characteristics of settlements. The use of baked bricks correlates to the socio-economic status of the settlement. I also selected baked bricks as a cultural marker of the urban period to study the characteristics of settlements.

Raw clay and husk architecture

Architecture made with raw clay and husk is a traditional method to make living spaces. The method is still present in some rural parts of India and Pakistan that are located far away from major cities. This type of architecture usually entails simple planning. For example, a single house consists of one, two, or three dwellings with an open kitchen and a courtyard. Construction materials are made with clay cow dung or by mixing it with straw or husk to strengthen the clay properties. Wood is the secondary material for making doors or roof rafters. These types of habitual spaces are subject to meltdown by rainwater and can be completely overcome by floodwater. The inhabitants need continuous conservation for the maintenance of houses.

Sun-dried mud brick architecture

The use of sun-dried bricks was also common in pre-urban period settlements. This type of building material is lighter than stones and easy to mould because of clay's chemical properties, and it is cheaper than baked bricks. In some archaeological sites, there is evidence of the use of both baked and sun-dried bricks. Sun-dried bricks take almost one-week of sun exposure for drying and become lighter in weight because of water absorption. The use of mud bricks was a common practice in village communities before the urban period. The pre-urban site Rana Ghundai is an example that exhibits the use of mud bricks, although the site is located in the Balochistan district where stone rubble is easily available. The quality of the thermal insulation of mud bricks might be the reason for its use (Khan & Lemmen, 2013).

Figure 17. Added straws in clay for durability and minimum shrinkage

Baked brick architecture

The third type of construction material is bricks baked in kilns. The use of baked bricks started from the urban period. During that period, the 1:2:4 standard ratio of bricks was produced and used for the construction of larger settlements. The process of transforming raw material for getting maximum durability and water resistance properties in the form of bricks required many resources and much energy. The effectiveness of baked bricks is much more than sun-dried bricks. Baked bricks provide a water resistant property to protect from floodwater and durability, compared to sun-dried bricks. During the thermodynamic process, the properties of the clay change. The part of the land in which we have vigorous use of baked bricks can never be part of natural land that allows vegetation (Akinshipe & Kornelius, 2017).

Stone architecture

This type of material was also used in Indus society settlements. Dholavira is an example that used stones as construction material.

From the above-mentioned discussion, it is clear that based on quantitative definitions of settlements, such as camp site, village, town, and city, we are unable to understand the complete nature and scale of the settlements. It gives a partial picture. This creates several problems related to the conceptual differences among settlement scales. For this reason, I adopted an attribute-based approach that is much beneficial to the study of Indus settlements to produce better data for comparative study (see details in Chapter 7). Based on these attributes, I have further scaled settlements and provided a better understanding regarding the urban process and development with the Indus society, as discussed in Chapter 7.

CHAPTER 4

Ganweriwala settlement: Physical survey and artefact analysis

The purpose of the present chapter is to analyse the socio-cultural and economic characteristics of Ganweriwala settlement with a systematic topographic survey. Towards this end, three complementary methods were employed.

1) Legacy data from previous investigations in the 1970s, 2002, and 2007
2) An accurate topographic map was produced using a total station
3) A targeted qualitative survey was carried out

The topography of Ganweriwala settlement is examined and the artefacts from the legacy data and the Gulzar collection are studied. The results of the survey and artefact study elaborated the approximate scale of the settlement and its socio-economic and cultural attributes during 2600–1900 BCE.

4.1 Background and the archaeological evidence of Ganweriwala site

Ganweriwala settlement is located in the middle of the Cholistan desert, about 27 km towards the southwest of the Derawar Fort (16th century historical fort). From the Derawar Fort to Ganweriwala settlement, the region is sandy mounds and flat plains, followed by the dry channel of the Hakra River.

The settlement plan, writing, and craft activities from the physical remains of the mound elucidate it as a major urban settlement of the Cholistan region (Mughal, 1997; Gulzar, 2020).

The archaeological discovery of the settlement was during the Cholistan regional survey by Mughal in 1976 introduced in the previous chapter. Ganweriwala site consists of two closely situated mounds with an east-west direction like other major Indus urban centers. The mounds of Ganweriwala covered a large area discussed below and exhibit remains of humaninduced environment. The surface of Ganweriwala is covered by millions of artefacts including pottery, beads, seals, toys, jewellery, and bricks. A selection of these artefacts have been collected randomly by different archaeologists over time from 1972 to 2015. Different parts of the settlement present different types of artefacts that may reflect the socio-economic activities discussed below. The archaeological data, artefacts, and settlement size from Ganweriwala site exhibit a contemporary settlement with Mohenjo Daro and Harappa.

Mughal measured Ganweriwala settlement and his announcement about the gigantic size caught the attention of archaeologists worldwide. However, Mughal could not continue further work on the settlement and placed collected artefacts from Ganweriwala at the Lahore Fort reserve collection that I named the Mughal collection in present work. The artefact collection was never studied or analysed before the present study. After Mughal´s work, there was a long gap in research history. In 2002, the site was revisited by Mark Kenoyer and the Punjab Archaeology Department. They examined its surface and randomly collected some artefacts, which were placed in the Harappa museum. In 2007, Ganweriwala was again visited by a group of archaeologists, including Mark Kenoyer from the University of Wisconsin, USA; Farzand Masih from the University of Punjab, Pakistan; and Toshiki Osada from the University of Kyoto, Japan. That collection is named the Kenoyer collection in present work. They mainly focused on the settlement's size and measured it. The site was described in terms of two mounds: Mound A (western) is 14.44 ha, and Mound B (eastern) is 10.31 ha, with an extended total area covered of 42 ha (Masih, 2018). Masih suggested that the site is 39 ha less than reported by Mughal. Both Mughal and Masih measured the site size with imperial tapes that have a greater margin of error and inconsistency. There was no further discussion about the socio-cultural attributes, economic functions, and materials discovered from within the settlement. Until recently, the site has only been the subject of descriptive studies and superficial disputes about its size (Kenoyer, 1997; Kenoyer, 1998; Mughal, 1997; Kenoyer, 2008; Masih, 2018).

The research history of other Indus's larger settlements had similar discussions at the initial stage of archaeological investigations. Mohenjo Daro was reported to be around 83 ha by earlier excavators (Mackay, 1938; Fentress, 1976). A later report published the size of Mohenjo Daro as 54 ha (Jansen, 1978). In the case of Harappa, the overall site size was estimated to be around 76 ha (Fentress, 1976). But in another report, it was estimated to be 43.2 ha (Fairservice, 1967).

In present research, I suggest that the analysis of a settlement based on only size scale can create several errors. Therefore, the dispute regarding the scale of Ganweriwala settlement created difficulty in understanding its socio-economic and cultural scale. It is unfortunate that the legacy data from Ganweriwala surveys was not considered to analyse its scale and instead the archaeologists focus on the disputable settlement size. The topography of Ganweriwala is highly changeable due to the desert environment and erosion conditions. Due to the current state of the mound and neglected legacy data, this chapter presents a comprehensive study of legacy data, current findings, and mound topography.

4.2 Environment of Ganweriwala settlement

The present-day environment of Ganweriwala settlement and its surrounding landscape is not suitable for human existence, cultivation, or animal husbandry. However, the Cholistan region presents a high number of the reported human settlements that developed in the region during the 3rd millennium BCE. The empirical evidence suggests that in ancient times the environmental conditions of the region were different than they are today. The Hakra River was a major source of water in the region, but some changes in rain patterns or river avulsions interrupted the flow of water, as discussed in Chapter 3. However, studies about the paleo-environment of the region are rare. In this present research, it is possible to say that the socio-cultural and economic practices might have caused an impact on the environment of the region. Humans have a tendency to mould the environment in several ways and some of them are discussed below.

4.2.1 Impact on land resources

Large-scale urban development had a significant impact on the vegetation cover. Dense and compact urbanism is responsible for greenhouse gas emissions. The present-day study of greenhouse gas emissions clarify that the urban centers situated in rural areas have more carbon emission per capita (Glaeser & Khan, 2010; Carney, et al., 2009). Another element is garbage production and accumulation; cities have the potential to produce garbage at large scales that can affect the regional environment.

The Cholistan region developed denser urbanism compared to any other region and, thus, had the tendency to cause a greater impact on the environment. However, more research is needed.

4.2.2 Impact on the natural environment

The Indus urban centers were built with baked bricks. There is an estimate that creating the amount of bricks used in the Mohenjo Daro would cause 200 ha of riverine deforestation (Homji, 1973). There is no direct evidence of where they produced bricks at such a large-scale, but Mughal mentioned several settlements in the Cholistan region that have evidence of brick production (Mughal, 1997). However, there is no direct evidence of brick production in any other region, including Harappa or at Mohenjo Daro. This interpretation makes the Cholistan an extremely crucial region.

Brick making needs two essential components for composition: first, raw material or soil; and second, fuel for baking such as wood or coal. The use of wood as fuel accelerates deforestation and causes the emission of greenhouse Gases, such as carbon monoxide (CO), carbon dioxide (CO2), nitric oxide (NO), methane (CH4), and nitrogen oxide (NOX) (Abdalla, et al., 2012). To build an urban center in a fertile land might be a reason to remove the green forest from river banks, which would cause harmful effects for microorganisms and the migration of wild animals (Abdalla, 2015).

Bricks also absorb and reflect more energy than soil or vegetation, which is why the temperature of the cities becomes greater with the density of structures. Increased temperatures can cause changes in rain patterns and ultimately can cause flooding, river avulsions, and the changing of river courses (as discussed in the next section).

4.2.3 Impacts on the natural hydrosphere

Another important change is a disturbance of the hydrosphere. The replacement of undisturbed soil and natural vegetation to the dense brick structures caused less absorption of rain water into the ground, so it directly flowed to the river or main stream. These changes can disrupt the small stream flows and can cause flooding. Water quality of the rivers can lead to sedimentation in time due to urbanisation (Uttara, et al., 2012). The dried riverbed of Gagghar Hakra might be due to the density of human expansion around its bank, along with natural hydro changes.

4.2.4 Disturbance of natural habitats of microorganisms

Natural habitats of several species can be disturbed because of urbanisation. Urban areas push back several small organisms by changing their natural habitat, and that forwards a new system for microorganisms, birds, and other related animals.

4.3 Survey method

The aim of the survey for present study was to analyse the settlement size, surface, and artefacts. Thus, the results of the survey provide an approximate value of the settlement's scale; however, the results are tentative and can be variable in future work. The method I applied for the documentation of Ganweriwala settlement has already been used during settlement surveys. Wright used to map the sites in the Beas Landscape and Settlement project, though with a representative gridding at the Vianiwal settlement (Wright, 2010). Miller also used a similar approach to trace copper workshops at the Harappa settlement (Miller, 2005).

Ganweriwala site was examined using a systematic surface survey (discussed in Chapter 2). At first, the site was surveyed, and off-site areas were also examined. The boundary extent was observed based on the artefacts spread over the surface. The site was divided into four parts for detailed investigations. The detailed investigation of topography resulted in different artefact densities in different parts. More than 30 artefacts in 1 x 1 m transect refers to a high-density area. Less than 30 artefacts in 1 x 1 m transect refers to a low-density area. Six locations from the greater density areas were selected for collecting samples from the mound 1a and b. Artefacts were collected from these locations. We only collected some bricks from mound 2 and could not collect artefacts from that part of the settlement because major parts were covered by desert bushes and there was a high risk of encounters with snakes and other wild insects. The collected number of artefacts was also limited because the major focus was settlement mapping. I, of course, compared the collected artefacts with the legacy data set.

Secondly, a contour map of the settlement was made using GPS and Total station. The results of the topographic survey and the collection of surface material present the approximate extent of the settlement's size, spatial distribution of artefacts, and cultural and economic characteristics.

4.3.1 Mapping

All human-induced physical features and natural topography were surveyed using the Electronic Distance Measurement (EDM) tachometry method. For the topographic survey, Sokkia-made Model 630 RK Electronic Total Stations were used. With Total station, at least two reflectors use the same target height.

The topographic survey was comprised of permanent control points, benchmarks, and global coordinates, traversing, and levelling. The survey of the whole site was performed at a scale of 1:1000. Three benchmarks were established for the survey work and the coordinates for the main control points were derived from GPS observations. The elevations of the control points were also derived using GPS. The total area was surveyed in two steps as discussed below.

- Traverse Survey Procedure
  The distances were measured in both back and forth directions, and the mean provided within an accuracy of 11,000. Angles measured on both faces on two zeros with four pointing in each direction, and the mean used for calculations.

  The distances are field-observed horizontal distances (true distances). The traverse data was adjusted using the Bowditch method: an accuracy of better than 1,100,000 was achieved.

- Levelling Procedure
  The line of collimation was checked at the start of the work. Levelling of the area was done using Electronic Total Stations made by Sokkia, Model 630 RK, by keeping their vertical axis fixed at 90°. The traverse control points were used as benchmarks for levelling. A levelling accuracy of ±12 mm√K, where K is the distance in km, was achieved.

The data collected in the field was processed in Pro link software and exported into Auto CAD dxf format. All permanent and temporary features are shown using different symbols in Figure 20. A jeep track separating the mounds into four parts is also shown. The contours were established with a 1 m contour interval, with every 5th contour being identified as an index contour. Heavy lines identify the index contours. The drawings were generated at 1:1 000 scale. For generating contours, Eagle Point software was used.

4.3.2 Sampling and artefact analysis

Artefacts from Ganweriwala site were randomly collected. The author selected at six different locations on the surface of Ganweriwala for a random collection within 1 x 1 m transects. The aim of the collection was to collect Indus urban period artefacts, such as beads, specific cooking pots, clay tablets, bangles, etc. The two mounds of Ganweriwala are separated by a jeep track, and the artefacts were collected from this part. This area is named as Track. The artefacts were handed over to the Harappa museum and analysed at the Harappa museum artefacts laboratory. The artefacts were analysed by characteristic study with a focus on their types and attributes. Some major categories were derived and discussed below. Later, a limited number of artefacts were sent to a laboratory for SEM-EDX analysis discussed in chapter 6.

The total assemblage of artefacts from legacy data and from the Gulzar collection have been studied and analysed. From the presently available, total assemblage of Ganweriwala artefacts consists of 34%

from the Kenoyer collection, 23%from the Mughal collection, and 43 % from the Gulzar collection. The Kenoyer and Gulzar collections are placed in the Harappa museum and the Mughal collection is placed at the Lahore fort museum.

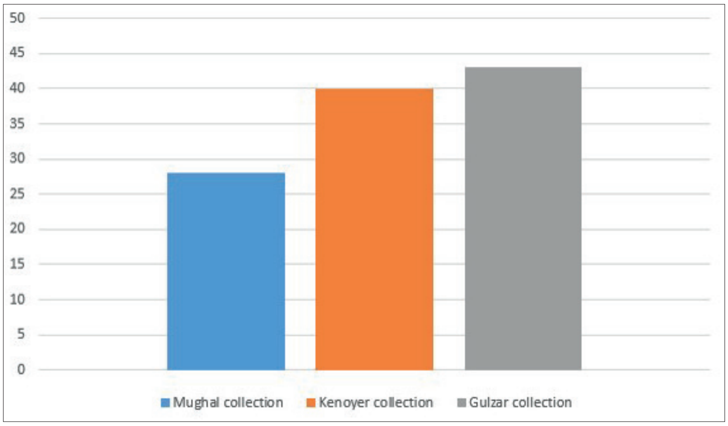


FIGURE 18. Studied artefacts from three different collections

All artefacts from the legacy data and from the personal collection were studied, but only 68 were selected to be documented in the present study. The selected artefacts exhibit important socio-economic and cultural attributes of Ganweriwala settlement. The total assemblage of artefacts provide an approximate value of the activities performed on the settlement.

The total assemblage presents the aim of different surveyors. For example, the total assemblage shows 2% bricks in contrast to several baked bricks spread on Ganweriwala surface. But, I collected only one brick to study in the size ratio. For this reason, the percentage of the artefacts shown in the figure 19 presents the collection assemblage, not the assemblage on the surface of Ganweriwala site.

Most of the artefacts are from daily used households such as cooking pots, plates, dish on stand that constitute 34% of the total study; jewellery constitutes 30% of artefact assemblage; some special objects constitute 23% of the total study; 2% are bricks; 5% are figurines, and 3% clay tablets. Further, the selected artefacts were analysed using type-variety analysis discussed in Chapter 2. The total assemblage of the artefacts from the Lahore Fort museum, the Harappa museum, and the Gulzar collection is examined and divided into three major groups based on the type, form, and design. The results are compared with the urban period artefacts to trace similarities and differences.

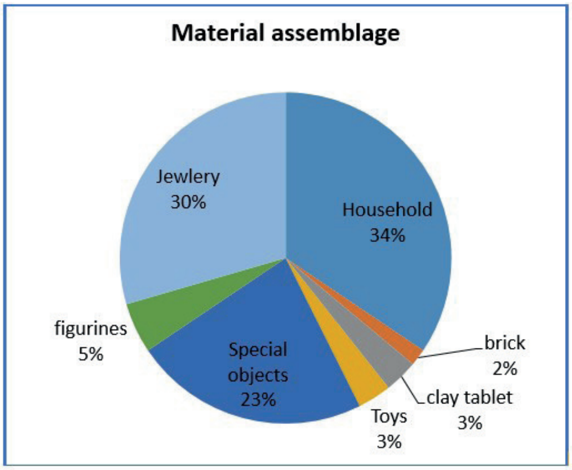


FIGURE 19. Estimated material assemblage from the legacy data and Gulzar collection

4.4 Topography

By analysing the topography of Ganweriwala site, the results of present research suggest that it covers an approximately 221,280 m^2 area. The site boundary is defined by a careful analysis of artefact scattered on the surface. As can be seen from the contour map in Figure 20, the total area of the site measured in the present fieldwork is about 66.7 ha. The site has two closely situated mounds, like other Indus cities, that can be seen from the drawing in Figure 20, which were reported earlier (Wright, 2010). The eastern mound is named Mound 1 and the western mound is named Mound 2. The area between Mound 1 and Mound 2 is a low depression of approximately 50 m. The concentration of artefacts within the depression is much lower as compared to the other parts of the mounds. The depression between these two mounds is a significant feature of excavated Indus urban centers such as at Mohenjo Daro. The division of Upper and Lower town is followed by a 200 m passageway (For details see 5.1.4). The depression between the two separate mounds is an indication that the settlement was divided into Upper and Lower parts like other large urban centers. This division might be used for movement of vehicles, transportation of goods, or might create a class difference between higher status and lower status population.

These two mounds are divided into four parts by a jeep track on the top of the mounds, as mentioned in Figure 20. I arbitrarily named the two mounds Mound 1 (eastern) and Mound 2 (western), as labelled in figure 20 with blue squares. Further mounds named A, B, C, and D are separated by the jeep track, as discussed in figure 20 (Gulzar, 2020). Mound 1 is divided into Part A (north) and Part B (south). Mound 2 is divided into Part C (north) and Part D (south). The northern part of Mounds 1 and 2 is surrounded by several small and irregular mounds, as discussed and shown in the contour map in the figure 20.

All parts were investigated one by one starting from A to D. Seven locations were chosen for transects. I examined three 1 x 1 m transects of Part A at different locations named A1, A2, and A3. Each transect unit was observed and the pattern of artefacts was recorded. Two transects of 1 x 1 m were established at B named B1 and B2. Part C, was inspected without any transects because of the vegetation on it and its Lower density of artefacts compared to Parts A, B, and C. At part D, only one transect was examined known as D1 as mentioned in the figure below. One transect was investigated at the jeep track and labelled as T. Parts A, B, C and D exhibit different patterns of artefact assemblage. For example, Part A presents mostly craft production, Part B exhibits mostly household items such as cooking pots and storage jars, and Parts C and D exhibit bricks but a lesser amount of artefacts compared to Parts A and B. The details of these parts are given below in figure 21 and 22.

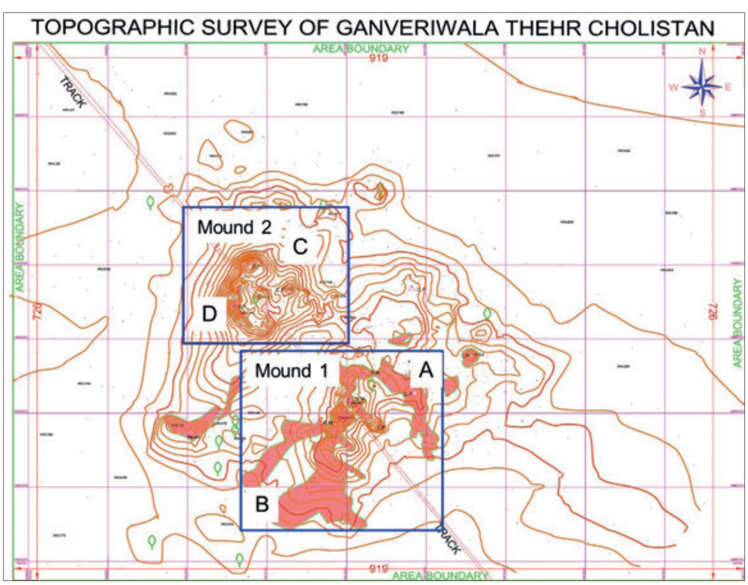


Figure 20. Contour map of Ganweriwala represents that the total mounded area of 66.7ha is divided into two major mounds named mound 1 and mound 2. Both mounds are further divided into 4 parts named A, B , C, D. Red coloured parts show the densely covered area with artefacts clusters.

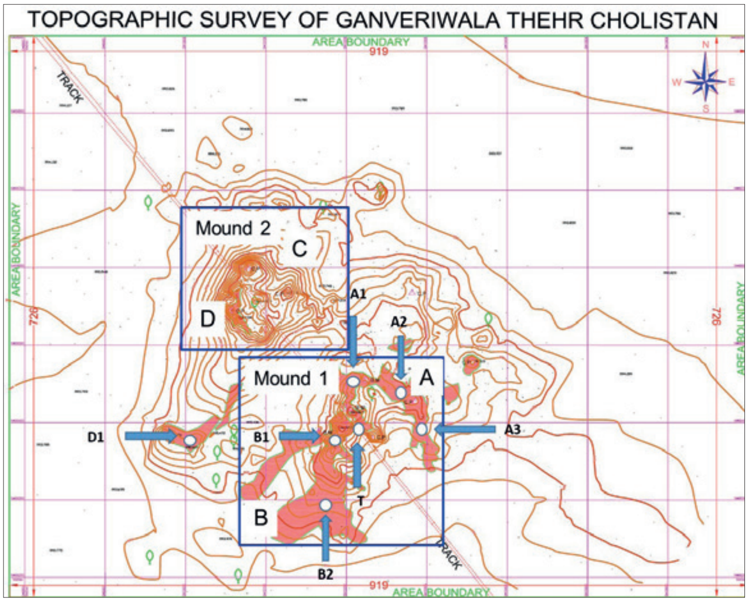


FIGURE 21. Map shows the locations of investigated transects

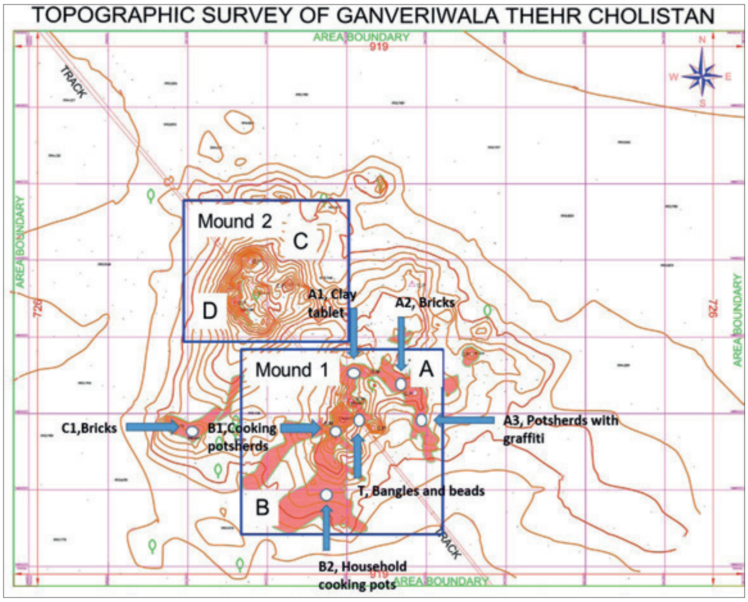


FIGURE 22. Map showing the types of artefacts from different transects

Mound 1

Mound 1 has a richer density of artefact clusters compared to Mound 2. Countless artefacts are scattered on the surface of the mound and also at ground level. Mound 1 is divided into two Parts arbitrarily named as part A (towards North) and part B (towards South). Mound 1, Part A has a large number of artefacts associated with craft production such as beads, bangles, blades, and clay tablets. Two transects were selected at Part A: A1 at the northeastern part, and A2 at the southwestern part. I collected baked bricks, perforated potsherds, pieces of a toy cart, and a grinding stone from that part. Artefact patterns of Mound 1, Part A exhibit industrial activities such as baking pots, craft production, and seal making. Industrial and administrative types of artefacts have been discovered from that part such as beads, a dish on a stand, and clay tablets.

From A1, we collected some bricks. From A2, I collected a clay tablet with Indus writing (Gulzar & Parpola, 2016). Both transects provide nearly similar types of artefacts, for example, sherds of pointed base goblets, TC cake, and potsherds of different types.

Part B of Mound 1 also has a high-density of artefacts. The artefact assemblage from this part comprises utilitarian artefacts associated with households: cooking pots, perforated jars, and storage jars.

A large number of the pot bases were also collected randomly from Mound 1. These bases of the pots contain graffiti marks that might represent different potter industries or might belong to the early development of Indus script.

Figure 23. Ganweriwala mound 1, Parts A and B from left to right

Figure 24. Part A, shows highest density (more than 30 artefacts in the 1X1 transect) of artefacts in the figure

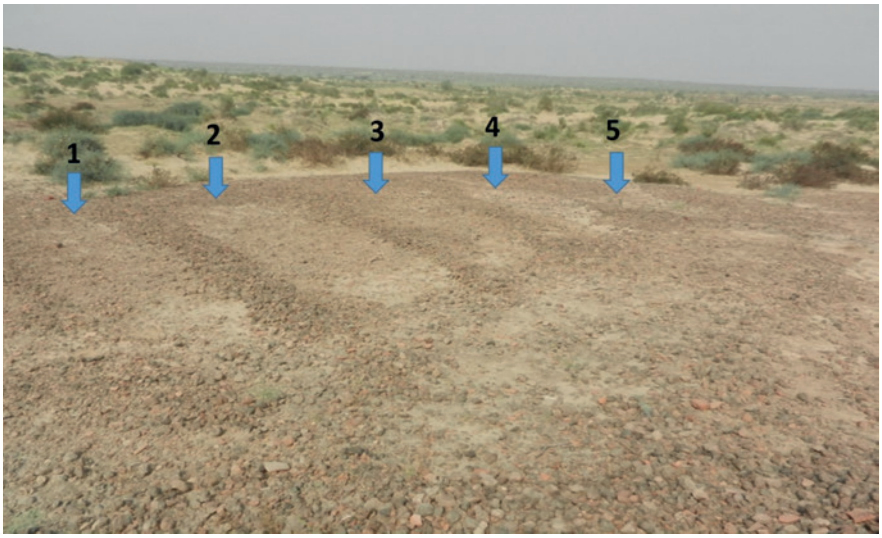


Figure 25. Ganweriwala Part A , artefact clusters exhibit a special feature of 5 rectangular units on the surface. This type of artefact clustering is not indicated from other parts of the mound. The patterns of the artefacts can indicate buried structures, but excavation is required to confirm this suggested interpretation.

Figure 26. Part A, A broken terracotta pipe or what might be a long neck of a vessel can be seen in the figure. This type of pipe can be used in toilets for drainage.

Figure 27. Part B, has a large quantity of broken pieces of food storage jars, cooking and processing pots as shown in the figure.

Mound 2

Mound 2 is located on the west and has a lower density of artefact clusters compared to Mound 1. Mound 2 is divided into Parts C and D. Part C is heavily covered with desert bushes, so the artefact clusters are less visible. We collected a few artefacts from this part. Part D has less dense clusters of artefacts compared to Parts A and B of Mound 1. But there were large amounts of bricks scattered at this part. We investigated only one transect at part D labelled as D1. Part D has several bricks scattered on the surface. Transect D1 also has several bricks but there was not any clear structure. It can be because of erosion and environmental conditions. In the Gulzar collection from D1 are bricks. These bricks are standard size bricks used for the construction of the Indus settlements.

FIGURE 28. Mound 2, Parts C and D (from right to left) have less density of artefacts as compared to parts A and B in Mound 1.

4.5 Artefact analysis

During settlement survey, a number of selected artefacts were collected. The ratio of selected artefacts from different transects are mentioned in the chart below. The maximum collection was from Mound 1, Part A, transect northeast.

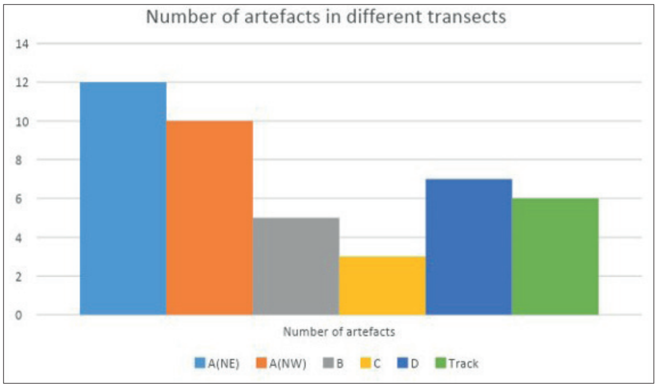


FIGURE 29. Number of artefacts from different parts of Ganweriwala

The following chart is the quantity of selected artefacts that were collected from different parts of Ganweriwala mounds in December 2015. Most of the collection is from Mound 1, A1 (NE): 12 artefacts, from A2 (NW): 10 artefacts, from B: 5 artefacts, from C: 3 artefacts, from D: 7 artefacts, and 6 artefacts were collected from the jeep track. The 68 selected artefacts associated with the urban period are presented in table 3 and pictures are presented in appendix.

Object no	Object	Fabric	Time period	Description
1	TC cake	Teracotta	2600-1900 BCE	Triangular TC Cake widely found at large settlements actual function is unknown might be used for pottery production
2	Perforated jar	Terracotta	2600-1900 BCE	Use for making beverages and draining the food
3	Toy cart	Terracotta	2600-1900 BCE	Play object used as toy
4	Chert Blade	Terracotta	2600-1900 BCE	Sharp edge kot dijian style blade
5	Bead	Terracotta	2600-1900 BCE	This type of bead used in jewelry
6	Bangles	Terracotta	2600-1900 BCE	Different sizes of bangles
7	Stone ware ban-gle	Shell stone	2600-1900 BCE	Finely carved pieces are from shell stone
8	Pointed base goblet	Terracotta	2600-1900 BCE	Plain surface base of small size pot
9	Cooking Pot	Terracotta	2600-1900 BCE	
10	Dish on stand	Terracotta	2600-1900 BCE	Broken pieces of dish on stand used for serving or decoration
11	Perforated jar	Terracotta	2600-1900 BCE	Medium size perforated potsherd
12	Rim of cooking pot	Terracotta	2600-1900 BCE	Medium size cooking pot
13	Pointed base goblet	Terracotta	2600-1900 BCE	Small size pot's pointed base
14	Base of the Pot	Terracotta	2600-1900 BCE	Plain surface base with graffiti mark
15	Neck of the pot	Terracotta	2600-1900 BCE	Black on red with circular motif and dot in every circle
16	Miniture pot	Terracotta	2600-1900 BCE	Small pot with plain surface
17	Miniature pot	Terracotta	2600-1900 BCE	Small pot with plain surface
18	Lid	Terracotta	2600-1900 BCE	Pointed base lid of cooking pot
19	cooking pot rim	Terracotta	2600-1900 BCE	Body of plain surface medium size cooking pot
20	Ball	Terracotta	2600-1900 BCE	Small ball with plain surface
21	Bangles	Terracotta	2600-1900 BCE	Small and large size of bangles
22	TC cake	Terracotta	2600-1900 BCE	Plain surface triangular
23	whistle	Terracotta	2600-1900 BCE	Whistle might be used as toy
24	Female figurine	Terracotta	2600-1900 BCE	Body of a female figurine
25	Fan head female figurine	Terracotta	2600-1900 BCE	A special female figurine
26	Miniature pot	Terracotta	2600-1900 BCE	Plain surface small pot
27	Animal figurine	Terracotta	2600-1900 BCE	Animal with two large horns
28	Ball	Terracotta	2600-1900 BCE	Small ball with incised geometric patterns
29	Bead	Terracotta	2600-1900 BCE	Finely made jewellery bead
30	Bangles	Terracotta	2600-1900 BCE	Different size of bangles
31	miniature pot	Terracotta	2600-1900 BCE	Small pot with plain surface
32	Bead	Terracotta	2600-1900 BCE	4 cm long bead of necklace
33	Body sherd	Terracotta	2600-1900 BCE	Plain surface with a slight relief on surface
34	Body sherd	Terracotta	2600-1900 BCE	Red on black with vertical line on neck
35	Body sherd	Terracotta	2600-1900 BCE	Plain surface

Object no	Object	Fabric	Time period	Description
36	Base of the Pot	Terracotta	2600-1900 BCE	Slight pointed base of a small pot
37	Rim	Terracotta	2600-1900 BCE	Small pot might be used for storage
38	Bangles	Terracotta	2600-1900 BCE	different size bangles of terracotta
39	Neck of the pot	Terracotta	2600-1900 BCE	Narrow neck of water container without decoration
40	Base of the Pot	Terracotta	2600-1900 BCE	Narrow long base of a vase without decoration
41	Plate	Terracotta	2600-1900 BCE	serving dish with nail grooves design inside plate surface
42	Pointed base goblet	Terracotta	2600-1900 BCE	Plain surface might be used as disposable glass
43	Perforated jar	Terracotta	2600-1900 BCE	Looks like a medium perforated jar
44	Base of the Pot	Terracotta	2600-1900 BCE	Plain surface neck of water container
45	Body sherd	Terracotta	2600-1900 BCE	Cooking pot with a fine design on surface
46	Body sherd	Terracotta	2600-1900 BCE	Black on red sherd with 4 black paint vertical lines on surface with different widths
47	Bangles	Terracotta	2600-1900 BCE	Four different sizes of Bangles
48	Lid	Terracotta	2600-1900 BCE	Body sherd with a pointed knob on surface is a lid of cooking pot
49	Perforated jar	Terracotta	2600-1900 BCE	Small size perforated container
50	Perforated jar	Terracotta	2600-1900 BCE	Small size perforated container
51	Body sherd	Terracotta	2600-1900 BCE	Looks like pointed base goblet with imposing reliefs on surface
52	Base of the Pot	Terracotta	2600-1900 BCE	Round edge base of a small pot
53	Perforated jar	Terracotta	2600-1900 BCE	Small size perforated pot
54	Toy cart	Terracotta	2600-1900 BCE	Pieces of toy
55	Miniature Pot	Terracotta	2600-1900 BCE	Plain surface
56	Grinding stone	Terracotta	2600-1900 BCE	10 cm long rectangle shape stone with a slight edge cut on one corner
57	Miniature pot	Terracotta	2600-1900 BCE	Plain surface neck of water container
58	Neck of the pot	Terracotta	2600-1900 BCE	Plain surface neck of water container
59	Body sherd	Terracotta	2600-1900 BCE	Bodysherd of cooking pot with a slight relief on neck
60	Rim	Terracotta	2600-1900 BCE	Rim of cooking pot with plain surface
61	Bangle	Terracotta	2600-1900 BCE	Bangles in various sizes
62	Stone ware bangle	Shell stone	2600-1900 BCE	Bangle of finely carved stone
63	Base with graffiti	Terracotta	2600-1900 BCE	Base of a small pot with graffiti sign
64	Pointed base goblet	Terracotta	2600-1900 BCE	Might be used as disposable for drinking water and discard it
65	Lid	Terracotta	2600-1900 BCE	top hook of the lid that is found in Harappa and Mohenjo-Daro
66	Bangle	Terracotta	2600-1900 BCE	Plain bangle of large size
67	Body	Terracotta	2600-1900 BCE	Grey blackish body of the pot with several ridges on surface
68	Brick	Terracotta	2600-1900 BCE	Standard Harappan Brick with a ratio of 124

Table 3. Description of the artefacts discovered from Ganweriwala settlement. Pictures of these artefacts are attached in appendix

4.5.1 Classification of Ganweriwala artefacts

The total artefact collection is divided into four different groups based on morphological characteristics and functions. These groups are bricks, mnemotechnic, utilitarian, adornments, and toys. The largest group is utilitarian, which is further divided into subgroups based on morphology and decorative motifs.

Types of artefacts from Ganweriwala:

Bricks

Mnemotechnic artefacts

Adornments and toys

Utility artefacts

Bricks

Ganweriwala settlement has evidence of baked bricks. Several clusters of the bricks were randomly distributed at different locations of Ganweriwala surface. However, Mound 1, Part A and Mound 2, Part D have higher densities of baked bricks. The bricks measure 26.5 by 13.5 by 6.5 cm and weigh 3,243 g.

During the urban period, the Indus society people used a standard-sized brick with a ratio of 1:2:4, also known as the trademark of the Indus society masonry for constructing big cities (Possehl, 2002). The bricks discovered from Ganweriwala settlement have a similar standard ratio. They might use a special mould to keep the standard ratio. The standard size of Mohenjo Daro bricks used in walls is 28 by 14 by 7 cm. Results conclude that although the measurement size is slightly different from the bricks of Mohenjo Daro, the standardisation is similar with the ratio of 1:2:4.

Figure 30. Mound 1, Part A also evidenced bricks. The bricks shown in the figure are the standard size of 1:2:3 spread on the surface, but we could not find any built structure at the surface

Figure 31. Brick of urban period with dimensions of 26.5 x 13.5 x 6.5 cm (l x w x h)

The evidence of baked bricks from Ganweriwala site suggested that the region has sufficient raw material and fuel for the production of bricks. Mughal mentioned in his book about the evidence of a purely industrial site from the Cholistan region that produced bricks and pottery (discussed in Chapter 4) (Mughal, 1997).

Mnemotechnic artefacts

I discovered a clay tablet in Ganweriwala and graffiti pottery that contains Indus writing (Parpola, 2017). One clay tablet and copper seal were discovered in 2007 (Masih, 2018). The evidence of writing from Ganweriwala elaborates the socio-economic and urban development.

Figure 32. Base of a pot with potter's mark

Figure 33. Twisted clay tablet 1 with Indus script

Among the several artefacts, two clay tablets and a copper seal are the most important that evidenced writing.

Clay tablet 1 was discovered in 2015 by the author from the surfaces of Mound 1, Part A. The clay tablet is twisted in shape and eight signs of Indus script are carved on one side; the other side is plain. Clay tablet 2 was discovered in 2007. It is also a twisted clay tablet, but both sides of the tablet contain writing. Side A of the tablet contains three signs of Indus script, and side B contains a mythical scene of Indus religious ideology. The scene depicts a deity (could be either a man or woman or a religious person) seated on a throne in the yogi pose, and behind the throne there are some sacrifices or maybe a religious deity in meditation pose.

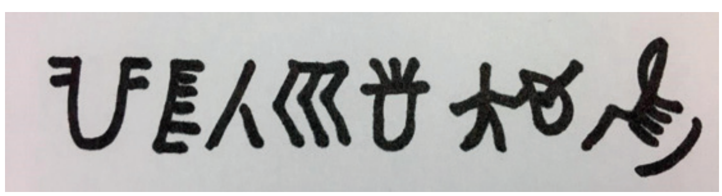


Figure 34. Clay tablet 1, Indus script consisting of eight signs (drawn by author)

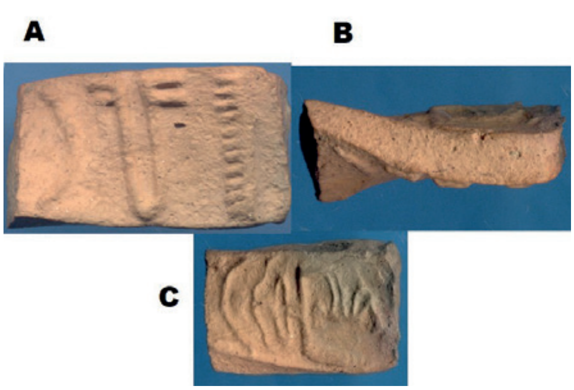


Figure 35. Clay tablet 2 from Kenoyer collection

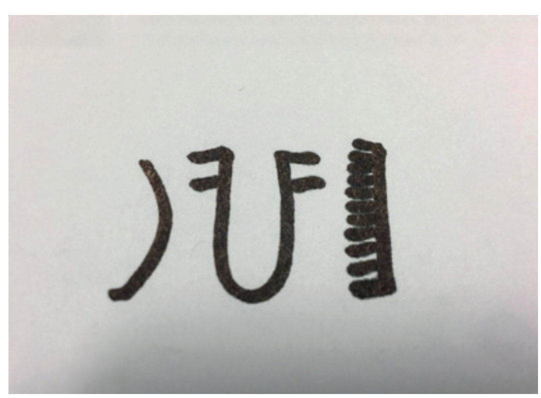


Figure 36. Clay tablet 2, side A, Indus script consisting of three signs (drawn by author)

FIGURE 37. Clay tablet 2, side B, Yogi posed human on a seat underneath a strange animal and there is a shadow over the head of the seated human (drawn by author)

Adornment and toy artefacts

The discovery of toys, jewellery, and figurines from Ganweriwala settlement assimilates its socio-cultural integrity during the Indus urban period. Different types of toy and adornment artefacts have been discovered from Ganweriwala. For example, balls, bull carts, and whistles are the most common toys. For adornment, mostly bangles and beads have been discovered. The artistic features of these objects are quite similar to the Indus Urban period artefacts, which suggests that the settlements have similar cultural values in craft production and rituals.

A study from the Harappa Project from 1986 to 1990 recorded 34,922 different types of bangles, from which 34,127 were terracotta, 390 were made of faience, 340 were made of shell, 48 were made of stoneware, and 17 were made of copper (Kenoyer, 1991). The results suggest that the average ratio of terracotta is 97.72% and shell is 1.12% from the Harappa settlement. Ganweriwala's surface collection gives us a similar ratio of terracotta and stoneware bangles, with the average ratio of terracotta bangles at 94% and stoneware bangles at 6% discussed in figure 38.

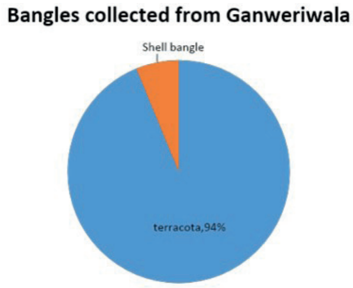


FIGURE 38. The ceramics and shell bangle assemblage for Ganweriwala

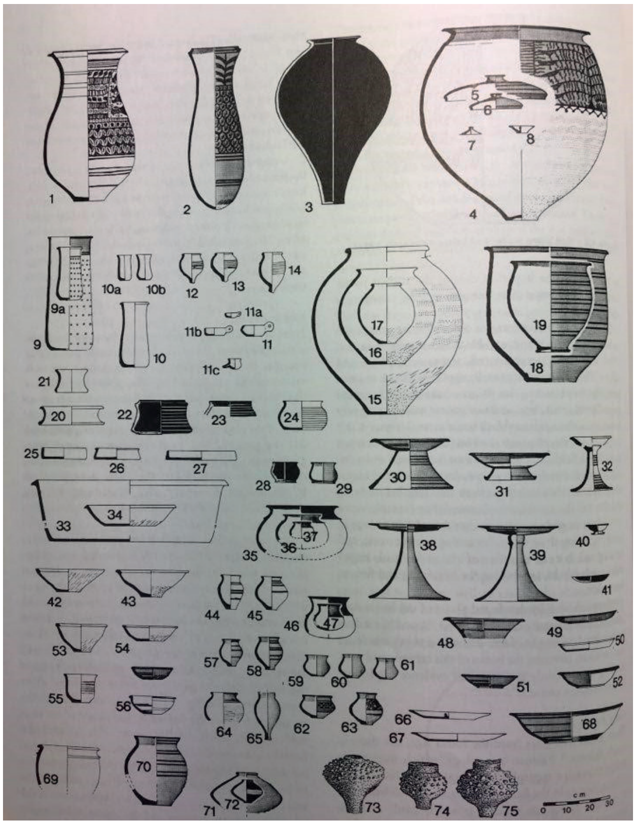
FIGURE 39. Broken pieces of stoneware bangles

Stoneware bangles from the Indus settlements are considered a special type of production. These bangles are discovered from only large urban centers and might be used only for the elites and are associated as a status marker (Kenoyer, 2000). Discovery of a stoneware bangle from Ganweriwala suggests that the settlement had similar types of status markers and special production, like Mohenjo Daro and Harappa.

Utilitarian artefacts

The artefacts belonging to this group comprise the largest quantity from the total assemblage. The most significant artefacts from this group are dishes on a stand, perforated jars, cooking pots, and storage jars. In this section, I have developed three subgroups of Ganweriwala utility artefacts based on morphological examination of the sherds and compared with the proposed scheme of the urban period artefacts by Kenoyer and Dales in 1986, as shown in Figure 40.

The types and forms of the pots described in Figure 40 are used to compare with the artefacts from Ganweriwala settlement.



Type 1, Cooking processing and storage vessels

This type consists of the artefacts that were used for cooking, processing, and the storage of food. Two rims are diagnosed from the urban period by comparing the established scheme of urban period pots. Artefact shown in figure 41, is similar to the drawing number 36 shown in figure 40 and another artefact shown in figure 42, is similar to the drawing number 16 shown in figure 40. Figure 41, is plain red fabric without any decorations, and figure 42, is a rim of a pot, with two horizontal lines of black paint visible on the neck. Figure 43 is the body of a perforated jar, which was extensively used during urban periods, and it resembles with the drawing 9a shown in figure 40. Figurines 44 shows knob of a covering lid and represent the drawing number 6 and 7 shown in figure 40.

Figure 40. Primary ceramics typology drawn by Kenoyer and Dales (1986)

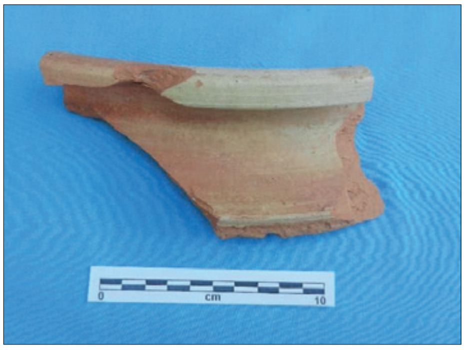


Figure 41. Neck of a pot

Figure 42. Rim of a cooking pot

Figure 43. Object 3, perforated jar

Figure 44. Handle knob of a lid

Type 2 Serving dishes

Potsherds associated with food serving have been discovered, such as plates, bowls, and a dish on a stand. Figure 45, is a piece of plate that seems to have been overfired and has nail impressions inside. This artefact represents a similar shape of drawing number 50, discussed in Figure 40. Figure 46 represents a dish on a stand and is possibly similar to the shape 32, 38, or 39, as shown in Figure 40.

FIGURE 45. Serving plate

FIGURE 46. Lower part of a dish on a stand

FIGURE 47. Base of dish on a stand-stand

Type 3, Miniature pots

This type of artefacts consist of miniature pots. The miniature pots might be used for transporting food in small amounts, decorations, or performing rituals. Three documented artefacts are similar to drawing 65 shown in figure 40.

FIGURE 48. Base of a dish on a stand

FIGURE 49. Complete miniature pot

FIGURE 50. Miniature pot

A few selected artefacts are analysed using SEM-EDX methods and are discussed in Chapter 6.

4.6 Discussion and summary: Ganweriwala case in the urban context

The present surface study and type-variety analysis of Ganweriwala settlement provides an approximate settlement scale and its socio-cultural characteristics during the urban period. For example, the initial studies at Mohenjo Daro and the Harappa settlements suggested that the actual settlement size was larger than the mounded area of the site, as discussed previously. In case of Mohenjo Daro, the first reported area of the site was 80 ha, which is similar to Mughal's proposed size of Ganweriwala site (Jansen, 1984; Mughal, 1997). Another important point is that the topographic map of Mohenjo

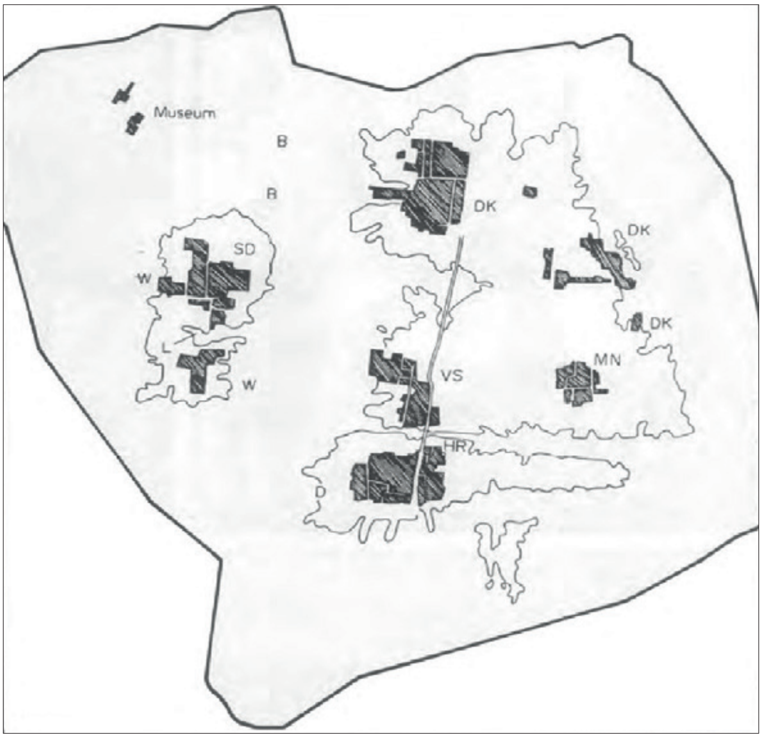


Figure 51. Mohenjo Daro, Map source: (Jansen, 1984)

Daro settlement from the earlier report has great similarity with the topographic map of Ganweriwala site, as shown in the figure 51 and compared in figure 52.

Ganweriwala's earlier suggested size by Mughal shows greater similarities with Mohenjo Daro. However, later measurements provide different results that are similar to Harappa's size. Based on these results, it is clear that the settlement was a regional urban center similar to the Harappa settlement.

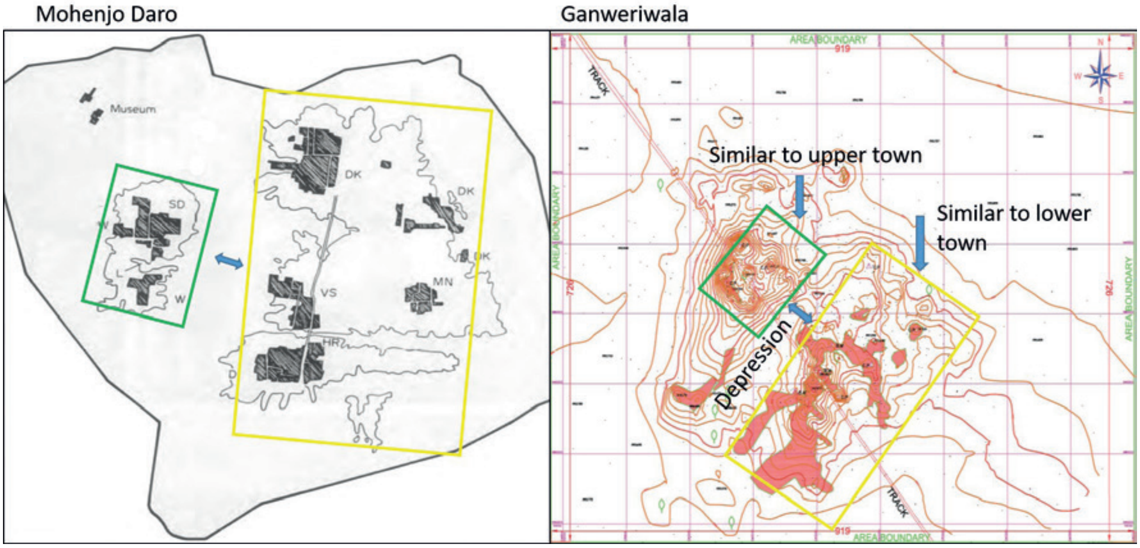


Figure 52. Comparison of the earliest topographic map of Mohenjo Daro and Ganweriwala . At earliest reports, Mohenjo Daro was reported to be an 80 ha settlement approximately similar to the earliest reported size of Ganweriwala , which presents the similar layout of Ganweriwala settlement.

Ganweriwala settlement in regional context

Ganweriwala settlement is located among a network of several smaller settlements ranging from 0.1 to 20 ha and forms a nucleated type of regional settlement pattern. In this nuclear type of settlement, Ganweriwala functioned as a regional urban center, as shown in the figure 53.

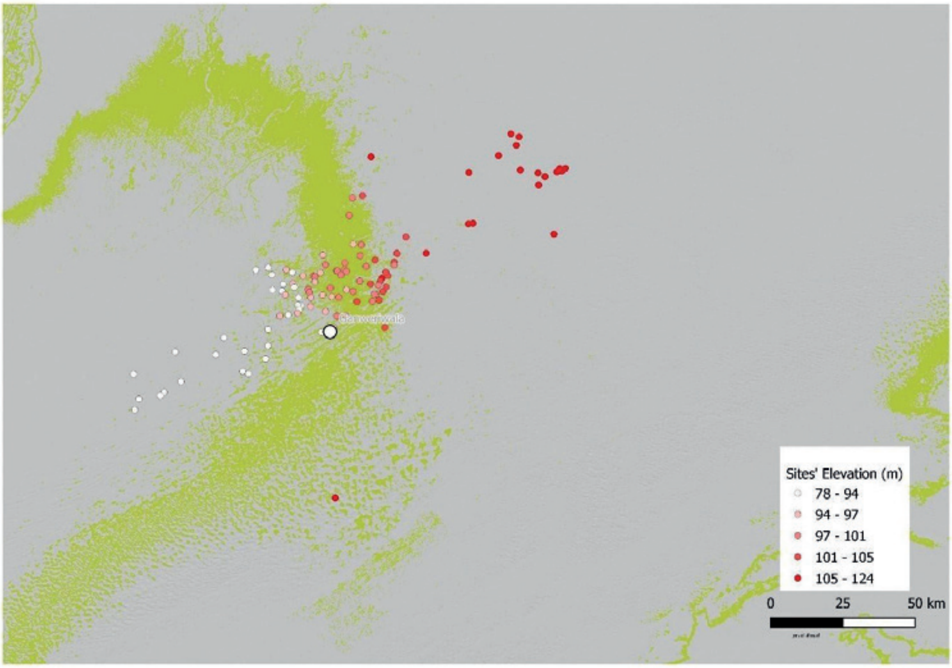


Figure 53. Ganweriwala in the network of smaller urban settlements

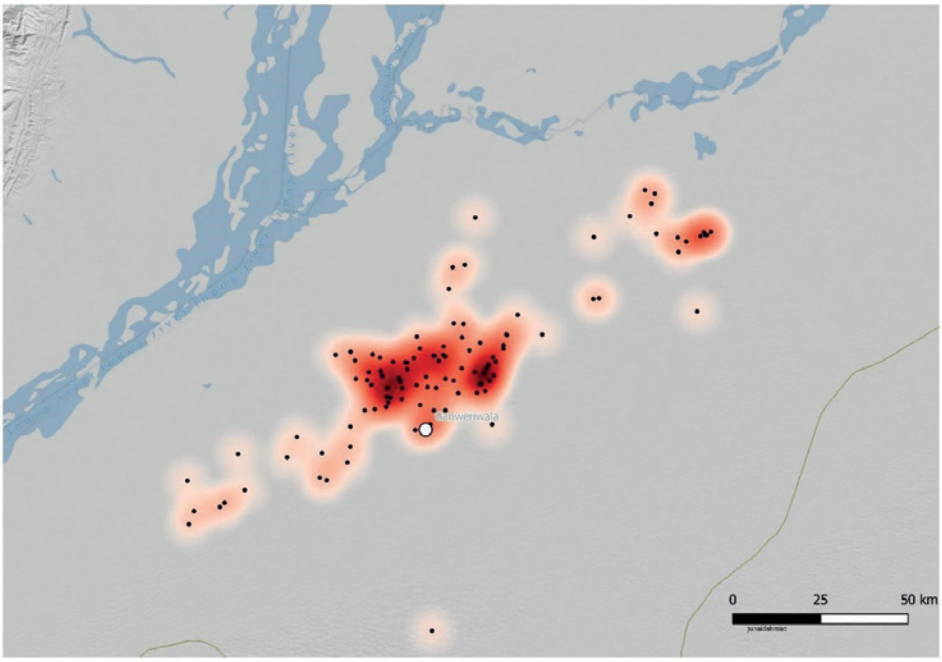


Figure 54. Density of settlements in the Cholistan region

Urban development in the Cholistan region with Ganweriwala as the major urban center

The artefact study suggests that the settlement gradually developed from a small sized village to a large settlement similar to the Harappa settlement. The study of artefact chronology represents different cultural periods contemporary to other urban settlements, and the estimation is the settlement was occupied around 3500 BCE and developed around 2600 BCE (Mughal, 1997). Mughal discovered a specific type of pottery from the Cholistan region termed as Hakra ware dated 3300-2800 BCE. Hakra ware vessels are handmade with a special surface treatment known as mud applique or incised pattern.

During my survey, I observed different types of artefacts belonging from the Hakra period to the post urban period on the surface. I only collected urban period artefacts. However, there are some Hakra ware artefacts in the legacy data that are shown in figure 55, 56, 57, 58, 59 and 60.

Figure 55. Incised Hakra ware potsherd

Figure 56. Rim of a Hakra ware pot

Figure 57. Incised Hakra ware

Figure 58. Embossed Hakra ware

Figure 59. Hakra ware with mud applique on the surface

Figure 60. Hakra ware with mud applique

During the pre-urban period, several socio-cultural, economic, and environmental changes might have happened that can be studied with further explorations. The artefacts and surface study of Ganweriwala that opened a discussion about its socio-economic and cultural characteristics are discussed below. The study of legacy data and surface material of Ganweriwala settlement postulated that the settlement was an important regional urban center and further studies and excavations are critical to understand the urban development of the region.

Climatic change evidence

The climatic conditions of the Ghaggar Hakra region is a much debated topic and still the knowledge about the ancient environment is limited (Dikshit, 2013). Some scholars suggested that Ghaggar Hakra was an independent river flowing parallel to the river Indus (Flam, 1981). Some suggested it never reached the sea (Possehl, 1996). However, the status of the Ghaggar Hakra river is highly debated and field investigations are limited. A recent study demonstrates that the Ghaggar Hakra region was subject to strong winter monsoon conditions and weak summer monsoon conditions between 4500 to 3000 years ago. The hydro-climatic changes of winter and the summer monsoon pattern impacted crop production and subsistence. The changes in socio-economy impacted the metamorphosis of urban development and caused a change in settlement pattern (Giosan, et al., 2018). But these studies need more research.

The evidence of ancient settlements from the Cholistan region during 2600–1900 BCE suggests that the environment of that region was definitely different from the present-day environment. At least, the environment was suitable for human existence and food production.

The settlement's existence in desert, settlement density, and present-day climatic conditions provide a platform for greater research opportunities. Further explorations of the region can produce critical inquiries regarding human interaction with the environment. Future excavations and research on the settlements can produce fruitful results about the nature of the River Ghaggar Hakra and the environment of the region.

Protected evidence

The archaeological evidence of Ganweriwala settlement is in a preserved state under the sand dunes of the desert environment. The complete evidence of a settlement plan and architecture is buried under sand dunes and is protected by the desert environment. Because of the desert environment, it is protected from human vandalism. The excavations at Ganweriwala can answer many unresolved questions about Indus society, which are unanswered because of the old documentation of the settlements. The complete evidence of Harappa city was removed before its excavations, as discussed in earlier chapters, and the problems associated with a high water table at Mohenjo Daro never allowed for a systematic study on the earliest levels of the settlements. To deal with these absolute problems, Ganweriwala is a critical settlement to get answers to unresolved problems associated with Indus urban development and its infrastructure. According to the latest knowledge, this is the only preserved large urban center. Investigations of this settlement with the latest technology and new methods can produce fruitful results.

Rakhigarhi is also situated in a village that is currently occupied by people, so it is difficult to get access for complete or reliable empirical data. Thus, Ganweriwala is one of the most important settlements because of its geographical location, nature and interact status.

Landscape, location, and settlement size

The geographic location of Ganweriwala is very important in that it is almost midway from Harappa to Mohenjo Daro and presents a controlled socio-economic structure of the society. The physical landscape of Ganweriwala site is unique because of the present-day desert environment and its large size. Both are significant factors to explain it as an integral part of the Indus society and urban setting.

The morphology of Ganweriwala mounds is correlated to the initial map of Mohenjo Daro, which suggests that the settlement is planned using a typical Indus grid plan known as Upper town and Lower town. Both parts of the town are followed by a main street as the central passageway for the movement of goods and transportation. The physical location of Ganweriwala settlement among the several small-sized sites explains the significance of the urban network and its urban function in the Cholistan region. The presence of Ganweriwala settlement in the network of several small urban settlements confirms its socio-economic functions as a regional center.

Socio-economic integration

The artefact patterns on Ganweriwala settlement and the study of legacy data suggest that the people of Ganweriwala were engaged in art and craft productions such as bead making, pottery consumption, seals, and figurines production.

The artefacts from the Mound 1, Part A shows industrial work such as clay tablets, blades, and beads were discovered from that part. Part B shows several different types of household vessels such as cooking and storage jars, a dish on a stand and perforated jars. The evidence of these special categories of objects demonstrate that this settlement was engaged in a high level of socio-economic activities.

Writing

The Indus society people used a mysterious language that has not yet been deciphered. They used different code words, symbols, and iconography, which were depicted in seals, clay tablets, and on different pots. Seals and clay tablets are the largest source of writing, elucidating their role in economic and administrative activities. A large number of objects such as clay tablets, pots, and ivory sticks with coded stamps were discovered within large Indus cities. During the urban period, the most common seals were bar seals, square-faced stamp seals with a written script, and pictography (Parpola, 2017). On more than half of the seals, there is a depiction of a unicorn bull facing a cult object. Seals are inscribed using male animal motifs, such as tigers, zebu, water buffalo, bison, and rhinoceroses. The results of legacy data and my own surface study show that there are not many seals that have been discovered from Ganweriwala and also from the other sites of the Cholistan region.

But archaeological evidence from Ganweriwala shows two clay tablets and one copper seal with writing evidence (Gulzar & Parpola, 2016; Masih, 2018). The Indus script discovered on pottery, seals, and clay tablets was from Ganweriwala settlement. The script consists of more than one elaborate syllable. Parpola suggested that the greater Indus region had one single language that was written and spoken by Indus people (Gulzar & Parpola, 2016). The written evidence from Ganweriwala strongly emphasises the language uniformity of the Indus region. The evidence of a shared language or script with other Indus urban settlements elaborated that Ganweriwala was an important regional center where Indus script was developed.

Graffiti

Ganweriwala artefact assemblage presents some special pots with graffiti signs. The graffiti signs were drawn on pot bases. In most cases, the rim and body pieces of the pots are absent. From artefact assemblage, eight sherds contain graffiti. Graffiti signs from different artefacts are shown in the figure 61.

The graffiti signs are defined as non-script. According to Parpola, Indus script usually contains a prolong text with several signs instead of just one sign (Parpola, 1994). These graffiti signs can be a preceding phase of Indus script, but the graffiti phase has been studied little (Quivron, 2000).

These graffiti signs from Ganweriwala site seem to be numerals following a system which is different from Indus script (Fig. 61). The graffiti signs from Ganweriwala assume a potter's numeral language for keeping a record of different categories of pots. This might be the first phase of the Indus script, as the pots contain these graffiti marks: no 1, 2, 3, 4, 5, 6, 7 which belong to Hakra ware. However, no 8 is depicted on an urban-phase pot on red fabric (See appendix figure 63). The cultural associations of the pots and graffiti marks show that Ganweriwala was an important urban center that contributed to the

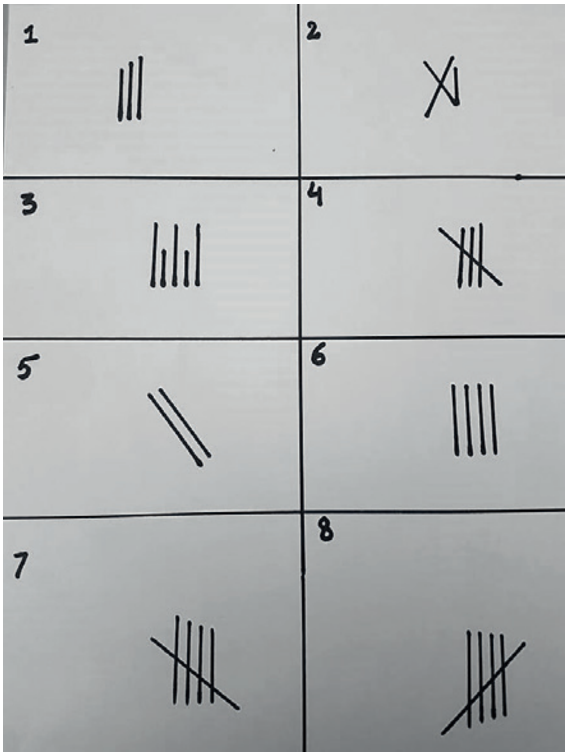


Figure 61. Graffiti signs from Ganweriwala drawn on different pots

development of Indus script. Discovery of a graffiti form of writing from Ganweriwala elaborated on how the settlement contributed to the long-term processes of Indus script development.

Socio-political integration

The Indus society urban centers have little evidence of socio-political integration, but the processes of ideological and socio-economic interactions can be used as tools to analyse socio-political integration of a settlement (Possehl, 1990; Kenoyer, 1992). The evidence of a stoneware bangle is crucial for elaborating on Ganweriwala's shared socio-political ideology and interactions with Mohenjo Daro and Harappa. Stoneware bangles are a rare type of special production that are only found at Mohenjo Daro and Harappa. This suggests that only elites or political authorities used these stoneware bangles, as discussed earlier (Kenoyer, 1997). These special bangles were only discovered in larger Indus settlements like Mohenjo Daro and Harappa. Discovery of stoneware bangles from Ganweriwala settlement is a significant indication that it shared socio-political ideology with other large urban centers and Ganweriwala was an important urban center that constituted Indus urban infrastructure.

Value system

The Indus urban culture shared a standard value system, such as the planning of cities, writing, and measuring weights. The best known example of standardisation are bricks. The use of the mud bricks recorded at the Mehargarh settlement around 7000 BCE and the use of baked bricks that were first discovered from the Jalilpur settlement around 2800 BCE. The use of mud-brick to the process of the baked brick was a transformation to new technology during the urban period. They used different sizes of baked bricks for the construction of walls, citadels, streets, drains, and houses in large settlements. The production of bricks was a costly process that required sufficient energy, skilled labour, natural resources, and production units. Raw material and fuel were the most important elements of the process. The riverine valleys of Punjab and Sindh were fertile enough to provide silt clay and wood as the fuel for baking bricks (Khan & Lemmen, 2013).

Baked bricks were abundantly available during the urban period (2600–1900 BCE) and almost found at every large settlement of the urban period. There are several different types of bricks, like relatively large bricks to make floors, wedged-shaped bricks to make corners or drains, and medium-sized bricks to make walls. All types and sizes of bricks followed a standard ratio of 1:2:4. The bricks discovered from Ganweriwala exhibit a similar ratio of 1:2:4, as discussed previously. That emphasises the fact that Ganweriwala site incorporates the Indus urban period value system.

Iconography and motifs

The figurine of fan-headed females and graffiti on pots present a unique type of Indus iconographic and socio-cultural traditions. This type of figurine and graffiti mark pots have been discovered from Mohenjo Daro and Harappa in large quantities. The fan headed female sculpture might present a special type of dance tradition or may present some special ritual. The exact function of this sculpture is hard to identify but its presence at specific urban centers elaborated on its importance. The fan-headed female figurine and graffiti mark pots have been discovered from Ganweriwala settlement. The discovery of these special figurines suggests that Ganweriwala had similar socio-cultural traditions like Mohenjo Daro and Harappa.

Domestic signature

Domestic signatures of Indus society have been discussed as a private expression of ideological integration by different classes of peoples living in the same city (Kenoyer, 1997). The artefacts from Ganweriwala present private and public expressions by people of different classes. For example, cooking pots, perforated jars, a dish on a stand, and pointed-base goblets are a few examples of common utilitarian products. However, pieces of shell bangle, terracotta beads, and fan-headed figurines elaborated that higher status of people also lived there.

Multifunctional site

The material culture reveals the significance of its multifunctional features during the urban period. The site provided a platform for work, such as craft production and residential purposes as well.

Summary

The present chapter is a detailed analysis of Ganweriwala settlements, surface survey, material collected by myself, and legacy data. The results of the present study demonstrate that Ganweriwala settlement covered approximately 67 hectares area. The area consists of the two different mounds that resemble typical Indus urban planning known as Upper town and Lower town. Different parts of the mounds show different types of artefacts density, and the categories are also discussed above. Characteristics and types of artefacts are described in detail and Ganweriwala settlement is discussed, especially in urban context. The results also show that the socio-cultural traditions, language, settlement plan and regional integration is similar to other large urban centers. Thus, further studies can significantly improve our knowledge about the Cholistan region, Ganweriwala, urban development across the region and climate change.

CHAPTER 5

Urban attributes of large urban settlements of the Indus society

Five major known settlements from the Indus society are briefly described and analysed below.

5.1 Mohenjo Daro

Mohenjo Daro is the largest known and excavated settlement of the Indus society. This settlement is one of the distinct urban centers of Indus culture due to its large size, urban planning and urban density. The Mohenjo Daro settlement was deliberately planned around 2400 BCE (Jansen, 1987). The mounds of Mohenjo Daro were reported to be approximately 84 ha in size by the earlier excavators, but later excavations and drill probes have suggested that the settled area is more than 250 ha (Kenoyer, 2000).

The settlement was discovered in 1922 and has been extensively excavated (Marshall, 1931; Mackay, 1938). Excavations at Mohenjo Daro are old and the documentation has several problems. There are confusing and inconsistent field recording methods, reports, and town schemes (Mackay, 1931; Marshall, 1931). The first excavations were performed by Marshall in 1931, which adhered to the basic recording matters/techniques discussed below. In 1964, the danger of deterioration forced a stop to further excavations.

Further excavations suggested that the walls of Mohenjo Daro had been eaten by sodium sulphate salt (Jansen, 1984). However, two research projects were launched by the Pakistan Department of Ancient Monuments led by the University of Aachen, Germany and the Institute of Middle and Far East, Rome. The project initiated by the University of Aachen was an exploratory work related to the architecture and planning of the city. This project examined the old reports, documentation, drawing photographs, and excavations notes. Their analysis described the technical details about various structural complexes and individual buildings and revealed a better picture of urban planning, social structure, and craft activities. The study of physical characteristics of the city provided information about pyro technologies, spatial architectural buildings, and systems related to hygiene.

I have briefly analysed and summarised the urban attributes from Mohenjo Daro, as given in table 4.

Major Settlement division	Upper town, Lower town
Structures	Great Bath, pillared hall, warehouse Residential or complex structures
Components	Wells, Streets, Drains, Fortification

Table 4. Major known components from the archaeological evidence

5.1.1 Setting

Mohenjo Daro is located in an arid climatic zone surrounded by seasonally fertile agricultural land, approximately 1.75 km on the left bank of the Lower Indus River and roughly 400 km north of the modern-day city of Karachi (Jansen, 1989). The present-day environment of the region is an arid and semi-arid subtropical climatic zone which is characterised by low rainfall, high temperatures, and low relative humidity. The rainfall of the region is the most variable element, with a low average and high variability. The annual rainfall varies from 70–100 mm, and there is no sharp line of any particular precipitation pattern (Saeed, 1998). Approximately 70% to 90% of the rain falls during the monsoon season between mid-June to mid-September. The months of July and August have the amount of maximum rainfall and are considered the wettest months. April, October, and November are the driest months. However, the weather of the region has great variations that differ year to year.

Concerning the physical remains of Mohenjo Daro, it consists of a collection of several mounds rising slightly up from ground level. The mounds are divided and connected into several discrete urban sections. The settlement is divided into two major divisions known as Upper Town or the citadel or stupa mound. The Lower division, referred to as Lower Town, is located in the western side, and is architecturally more complex. Both sections are separated by a north-south depression, with no architectural and habitation area evidenced.

5.1.2 Chronology of Mohenjo Daro

Mohenjo Daro is the subject of a long history of excavations and exploratory work; however, certain loopholes exist regarding excavation methodology, documentation, chronology, and spatial analysis of the architecture. Consider, for example, excavation methodology. The results reported from excavations do not address the stratigraphic problems scientifically (Marshall, 1931; Mackay, 1938). The methodological inconsistencies and lack of excavations limit our understanding about the urban development of the settlement. The settlement was excavated using the practice of rough stratigraphic levels, the nearest to the even stratigraphy-informed techniques that were employed to assign the architecture and associated artefacts to a site-wide chronology based on the elevation plan (Marshall, 1931). Some other errors are associated with the corresponding structures because, in some cases, artefacts are omitted from the discussion of architecture. Mackay used the terms 'room', 'chamber', and 'suite' interchangeably, but there is little explanation (Mackay, 1938). Excavated areas are arranged using Arabic numerals; blocks and houses are referred to using Roman numerals; and some areas assigned by the name of the excavators.

Marshall used mechanical and conceptual means to define Mohenjo Daro's occupation periods. He used seven layers of architecture to describe the occupation of the city and identified three periods of urban development known as Early, Intermediate, and Late (Marshall, 1931).

2000 BCE, Late (I, II, III)

2300 BCE, Intermediate (I, II, III)

2600 BCE, Early period

There were minor variations to the cultural layers, and he concluded that the settlement expanded vertically in a synchronous fashion. Marshall excavated a large part of the settlement and recorded cultural layers, artefacts distribution, and types.

The results from the Marshall's excavations were criticised by Wheeler (Wheeler, 1953). Wheeler was a known archaeologist because of his knowledge about stratigraphic problems and advanced methods in the field. Wheeler analysed the artefacts chronology, radiocarbon dating, and used the analogy and cross-dating of the Indus material recovered from Mesopotamia. He provided a relational understanding of certain architectural elements at Mohenjo Daro; however, there was no significant difference from Marshall's scheme.

The attempts to locate the earliest level of the city have never been successful because of high local water table levels (Jansen, 1987). However, from radiocarbon dating and cross-dating chronologically with Harappa, it is estimated that the city was occupied during 2600–1900 BCE (Kenoyer, 1991).

A systematic revision of chronology was performed by Aachen University in 1986. It created a three-dimensional stratigraphic reconstruction by revising artefacts from field registers and correlating according to excavation depths and the architecture in which they were located (Jansen, 1993) (ibid). They analysed the hydraulic infrastructure of the city and suggested that the drain network connected all building structures at a similar time. The evidence from the hydraulic system emphasises the deliberate planned character of the Mohenjo Daro settlement.

5.1.3 Construction materials

The main construction materials at Mohenjo Daro are mud and baked bricks; however, baked bricks were extensively used for buildings and mud bricks were used for platforms/foundations or fortification. The bricks have a standard ratio of 1:2:4 (Kenoyer, 1998). Gypsum mortar and mud mortar was also used to bond the bricks.

5.1.4 Re construction of the built environment of Mohenjo Daro

The plan of the Mohenjo Daro settlement is orthogonal in shape and seems to be semi-planned. The excavated area of Mohenjo Daro is 83,000 m^2 and was constructed largely with baked bricks with a 1:2:4 standard ratio. However, wood was also used as a construction material to make structures such as doors, windows, and rafters (Vidale, 2010). Upper town or citadel is smaller than the Lower town and less complex. It is constructed on an 18 m high platform to the alluvial plains (Jansen, 1993). The platform was constructed using mud bricks. The most notable structure of that area is the 'great bath', which is a monumental structure. However, Lower town is more complex architecturally. Between Upper and Lower town, there is about a 200 m division.

The Upper and Lower division is a known feature of Indus larger settlements as shown in figure 62. Although the area of Upper and Lower town have different sizes at different settlements, that can be noted at Harappa, Dholavira, and Ganweriwala settlements.

The setting and structural complexes of Upper town present unique urban features that are missing at any other known settlements of 2600 BCE. The Lower town consists of uniform domestically-focused structural complexes (Ratnagar, 1991). However, in a very recent study, it has been found that the structural complexes of Lower town have a variety of architectural styles, forms, and replicates. Few architectural features from the Lower town resemble the emblematic architecture of Upper town (Mosher, 2017).

Mosher observed these fantastic features during his PhD studies, and he concluded that there are many problems with the main source of Mohenjo Daro data. The total built up space of Mohenjo Daro was divided into areas, blocks, houses, and rooms defined by the earlier excavators and were used as the main source of data. An area was defined as the largest unit (Marshall, 1931). There is no measuring limit that creates a distinction of various areas. Citadel or Upper town is divided into the SD and L areas. Lower town is divided into the DK-A, -B, -C, DK- G south, DK-G north, DK-M, the Moneer, VS, HR-A, and HR-B areas. Arabic numerals are used for excavated areas, and Roman numerals are used for blocks and houses.

5.1.5 Stupa complex

To the east of the SD area, there is a circular stupa. The structure of the stupa complex has long been understood as a Buddhist period structure. The Buddhist stupa is a later addition during the Kushan period (2nd century AD), which was constructed on top of the original settlement of Mohenjo Daro (Saeed, 1998).

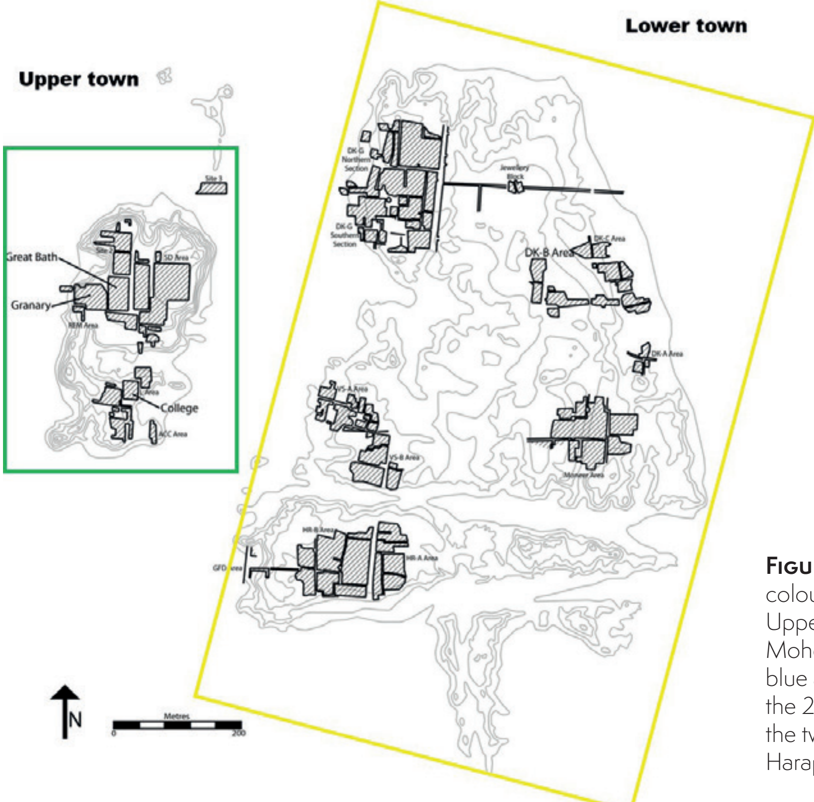


Figure 62. Green and yellow colour boundaries show the Upper and Lower towns of Mohenjo Daro, respectively. The blue arrow in between shows the 200 m depression between the two divisions, Map source: Harappa.com

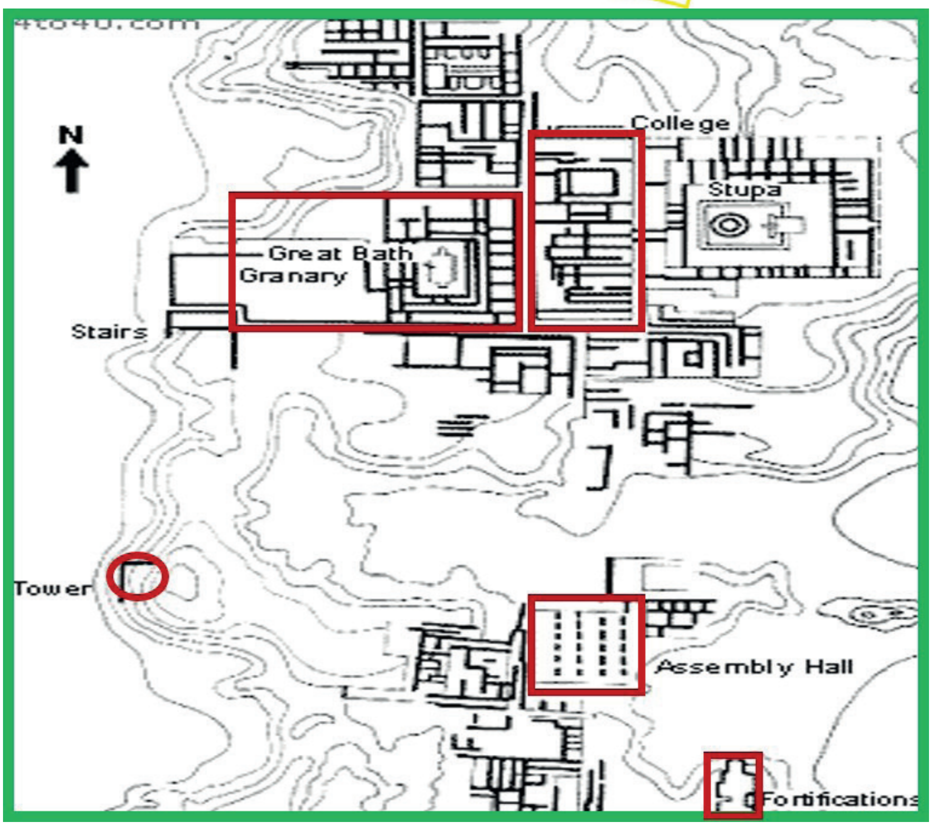


Figure 63. Upper Town of Mohenjo Daro with major structural remains of the great bath, college, granary, assembly hall, and fortifications, Map source: (Wheeler, 1968) Redrawn by author

5.1.6 Fortification

Jansen has proposed that the Mohenjo Daro was constructed in three different stages of bund construction made of mud bricks (Jansen, 1987). Upper town was constructed using massive mud bricks and is encircled by a wall. The estimation of this platform's construction is the erosion of soil and sediments of nearly 400,000 m^3 (Jansen, 1987). This unique structure can explain mainly the three functions of the elevation. First, it protected part of the settlement from floodwater; second, it divided the city into three different sectors; and third, it may represent the infrastructure of social classes.

5.1.7 Upper Town

The northern mound of Mohenjo Daro, referred to as Upper town, consists of mainly the SD area and a stupa complex. The structural remains of Upper town are the great bath, granary, priest's college, and the pillared or assembly hall. There are few remains of the fortification wall to the east of the pillared hall, but they are deteriorated and not clear. The prominent architectural feature is the great bath located in the SD area shown in figure 63 (Mackay, 1931).

To the western side of the bath, there is a warehouse structure constructed with wood and tapered with a thick flat roof. The walls and supports are made of timbers and wooden planks. Some parts of the wood are well preserved and some are in a perished form. The wood appears to be from deodar trees and might have come by being floated through the Indus River from Kashmir to Mohenjo Daro (Possehl, 2002). The warehouse might have served as a storage or giveaways goods of bath caretakers.

To the east of the bath, there is a hall structure known as the college of priests. That building is 70.3 m long and 23.9 m wide. To the north and south, it is conceived with larger rooms, and in the center there are smaller rooms. Its windows opened to the northern end of the bath.

5.1.8 Great Bath

The brick-lined rectangular structure located in the SD area is referred to as the great bath (Mackay, 1938). The structure covered an approximately 1700 m^2 area, measured 52 m north-south, and 32.4 m east-west. There was at least one Upper story and the great bath was a multi-storeyed structure (Possehl, 2002). However, a technical analysis of the north-east drain and the construction of the pool has suggested that the structure was not included in the original city plan but was a later addition to the older foundations (Jansen, 1989). The bath complex consists of three concentric zones enclosing the central pool structure. The innermost zone is the pool structure, the intermediate is the pillared gallery or veranda, and the outer zone is a public street. The three-zone approach to the design of the bath makes it a distinguished structure as discussed in figure 64 (Jansen, 1989). The internal or central part of the bath complex was a bathing area, which was a sunken rectangular structure measuring 12 m long, 7 m wide, and approximately 2.4 m deep, as mentioned in the figure 64.

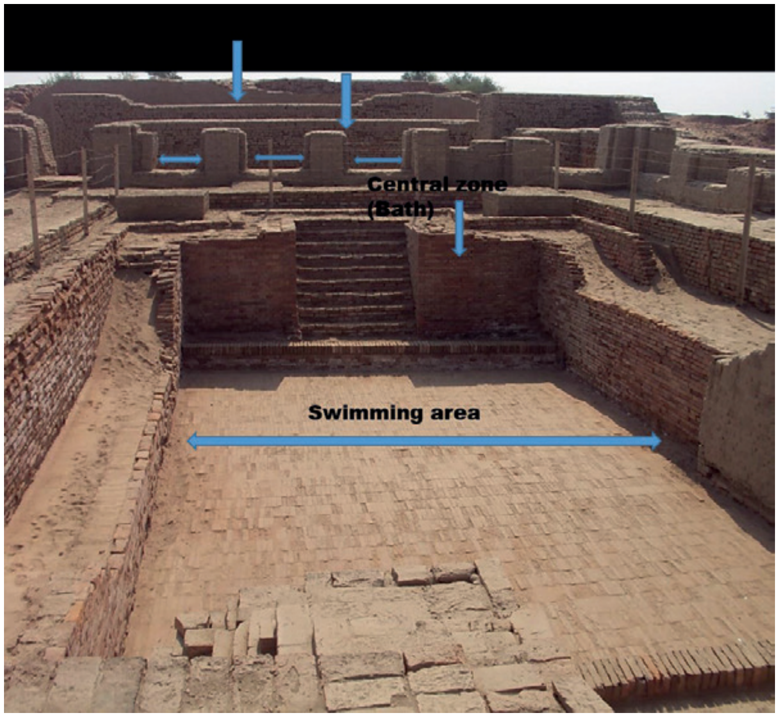


Figure 64. Three zones of the great bath and inner structure (photo by author)

The north and south ends of both sides had a 10-step staircase to the basin floor. The pool was built with uniform bricks pointing inward and laid using a stretcher bond with gypsum mortar. The joints between the bricks were only a few millimetres wide. An insulation layer of bitumen was applied to protect the bricks from shrinkage or water seepage. The structure of the double-walled swimming pool was surrounded by an outer wall, which protects against lateral pressure by the insertion of transverse walls and provides a foundation for the pillared gallery. The structure of the pillared gallery or veranda, also called the intermediate zone, was entered into through the south. The pillars were arranged in a sequence of two pillar-widths apart. The bath complex was entered through two main entrances in the southern façade and opened to the narthex-like structure, which was followed by an irregular passageway that entered the central pool zone and provided access to similar administrative units, which emphasises that cities were controlled by local rulers. Smaller rooms are to the north and east. The outer wall of the bath is about 2 m thick, tapered upward on an 80° angle, and built with English bond. The great bath complex is separated from the neighbouring buildings by a 5 m broad street. The street runs all around the complex and makes it a distinguished architectural structure of the Mohenjo Daro.

To the east, there was a smaller room that was connected to the pillared hall which contained a double- walled cylindrical well. That well might have been used to fill the pool with water, but Jansen suggested that it is unlikely to say that a basin having the capacity of 150 m^3 of water was filled by hand. However, the mechanism used for filling the pool with water is still unknown. The southwest corner of the pool had a drain that drained the used water through a long passageway to the main drain located in the street. The drain pipe is about 1.8 m high and is roofed by a corbelled arch. The extraordinary height of the drain might suggest it was used to keep a balance between the floor of the pool and the surface of the outer street. The drain runs about 8 m to the north and then turns northwest.

5.1.9 Lower town

The Lower town is architecturally a more complex part of the city shown in figure 58. Lower town consists of almost 300 closely packed structural complexes. They are dense and aligned. The excavated areas of that part were named after the excavators and are known as:

HR area HR-A HR-B

VS area VS-A, VS-B

Moneer area or DK area

DK-A DK-B DK-C DK-G

The architecture of structural complexes of Lower town was analysed by Anna Sarcina, who concluded that approximately 75% of the excavated structures of the Lower town can be classified as domestic architecture as discussed in figure 65 (Sarcina, 1979).

Figure 65. Lower Town of Mohenjo Daro with complex architectural detail, Map source: (Wheeler, 1953)

5.1.10 Structural complexes of lower town

One of the best known analyses of Lower town structural complexes is given by Anna Sarcina (1978, 1979). She evaluated the spatial and social structures of the Mohenjo Daro settlement with focus on the domestic architecture termed it as a private architecture (Sarcina, 1979). She particularly analyzed the architecture of Lower town and proposed typology of different house plans named after given colours. Her study was focused on the structure of the inner courtyard, whose archaeological record was not dominated by production activities, that type of structures recognized the type of domestic architecture. The courtyard was the major element that connected the small rooms and hallways. Sarcina proposed the following five models of houses based on architectural types. The evidence used are excavated units with an acceptably good level of preservation and archaeological documentation. Her sample consisted of 112 buildings all in all discussed in figure 66.

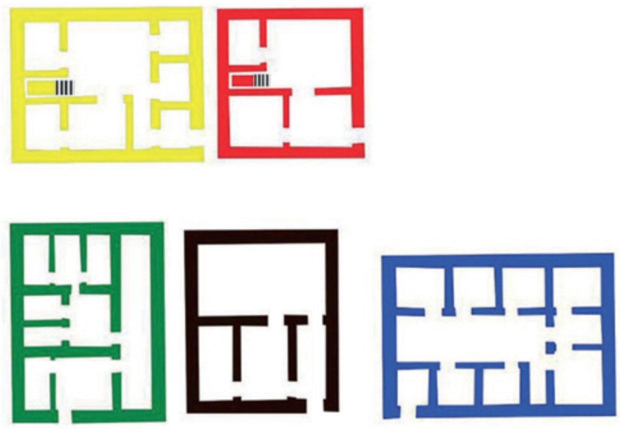


Figure 66. 5 types of houses model by Sarcina, Map source: (Sarcina, 1979)

Yellow model

The model of yellow building complexes is the most common and has been used for 58 houses with an average size of 104 m square. The 58 houses belong to the yellow model and have a north placed central courtyard. The courtyard is not directly accessible from the main street and is attached to an additional building. Another prominent feature of this model is the placement of two small rooms in the west. The larger room functioned as a kitchen and the smaller ones contain a staircase (Sarcina 1978, 159).

Red model

The red model has been used for 42 houses with an average area of 97.35 m square. These houses are smaller and less complex compared to yellow model houses. The courtyard of this model is located towards the north or north east corner of the buildings. The courtyard of this type of house is also not accessible from the street.

Blue model

The blue model is represented in only 2 houses with an average area of 130.42 m square. The courtyard of these houses is surrounded by a single row of rooms on three sides. The free side of the external wall is observed on both the east and west side.

Green model

The green model has been used for 6 houses with an average area of 183.60 m square. This type of house has a courtyard in the center of the building surrounded by small rooms on four sides. The courtyard is not accessible directly from the street. Sarcina also noticed that the spatial distribution of the rooms is more convoluted. All houses of that model contain a well.

Brown model

The brown model has been used for 4 houses with an average area of 106.70 m square.

Almost half of the area of these houses is devoted to a courtyard. The houses have rooms in the south and a courtyard in the north. The architecture of this type is less complex.

5.1.11 Streets

The streets of Mohenjo Daro follow an orthogonal pattern throughout the sections of the city. The sections of the streets were excavated time by time by different archaeologists and named after them. The southern part of Lower town was excavated by Hargreaves and named the HR area. The HR area is further divided into two parts: the eastern part known as HR-A and the western part known as HR-B. An elegant feature of the HR area is the 10 m wide street with a north-south alignment, which is known as First Street. There are several lanes that empty into First Street; however, the street runs along the blank walls.

Further north to the HR-A area, there are several large houses which are believed to be associated with high status people in the society or for those who could afford to live in large houses made with expensive baked bricks (Possehl, 2002). Complex buildings and streets follow the HR-B area. The most dominant architectural feature is house V, which is 1000 m^2 in size.

Just to the north of HR-B, there are the VS areas named VS-B (eastern) and VS-A (western). Deeply stratified deposits have been found at the VS area. Street alignment is poor in this area. The eastern part of the VS area is followed by the DK area known as the Moneer area. The DK area is further divided into DK-A, -B, and -C. A remarkable feature is a large street with an east-west alignment. The street has a drain system. That street goes towards the DK-G area and is called Central Street. The second largest street goes to the north and has a parallel position to First Street, and it is known as West Street. The parallel streets document the better planning of city logistics as a convenient transportation facility.

Figure 67. Main Street of Mohenjo Daro, Upper town intersecting east and west parts of the town (Photo by author)

The main Street is straight with a north to south direction, and is further divided into several lanes in an east-west direction. Main Street represents a grid-pattern alignment along with small streets (lanes).

First Street (7.6 m wide)

Second Street (9.1 m): runs north-south in Lower town

Central Street (5.5 m): the northern east-west thoroughfare in the DK-G area

The HR area consists of four different alignments of lanes, but all of them follow one reference grid that connects with Main Street. This connection between the reference grid and main Street is continuous to the VS area that is situated at a 90 m distance as shown in figure 67.

5.1.12 Water management and sewerage system

The most elegant feature of Mohenjo Daro is its water management system. The water infrastructure of Mohenjo Daro mainly consists of three elements: water procurement, bathing and toilets, and a sewerage system. The available evidence indicates that the people of the city used fresh water derived from vertical wells. An average catchment radius per well from available data is 25 m. If that figure applied to the whole area of the settlement including unexcavated areas, then the total settlement had approximately 700 wells with an average frequency of 1 well every third building complex (Jansen, 1989). The wells were built with specially designed wedge-shaped bricks. From a technical point of view, the cylindrical well shafts are an impressive feat of engineering, as they bear out the fact that the circular form is statically best suited to withstand the lateral pressure bearing on wells 20 m deep or deeper.

Apart from the well system, toilets and baths were also constructed within the houses. To keep hygiene a priority, the construction of bathing platforms and toilets was part of city planning. Bathing platforms were constructed in private houses. They were built along the street wall of the house to make for convenient drainage. The bathing platforms are either a reserved area of a room or a separate bathroom which consists of a slightly raised, sloping platform to allow the used water to run off the platform. These platforms were edged by a row of standing bricks which formed a shallow basin. In some cases, the bathing platforms are 80 cm high and were accessed through three or four steps. They sloped towards the corner, where the effluent was guided through a gutter or an outlet of the wall, through which waste discharged in the street drain or in the catchment vessel. These platforms often were associated with latrines in the outside wall, which were fitted with their own vertical chutes through which sewage discharged.

The waste and water was discharged through a network of drains that run parallel to the streets of Mohenjo Daro, as the streets and lanes have drains. The houses have intramural drains, vertical pipes, in walls to drain water. Mostly, drains run to the unpaved streets 50 or 60 cm below the surface (Jansen, 1989). The U-shaped cross section and the bottom of the drains were set in mud mortar and built with baked bricks. Different types of coverings, such as loose bricks, wooden boards, or flagstones, were used to cover the drains. The coverings were opened for the removal of waste or cleaning, and then covered again.

The drains were sloped at a gradient of 2 cm/m and met at different levels, depending on the depth. Cesspools were installed at the traverse or longer drains or at the point where several drains joined together. The method of installing cesspools was effective at avoiding waste clogs in the drains. They were probably covered with wooden planks. The waste deposits from the cesspools could be removed via steps down into the pit. Beside this cesspool installation system for domestic waste, open pit soaks were also in common use. When smaller lanes opened into a bigger street, open pit soaks were installed and needed to be cleaned from time to time (Jansen, 1989).

The houses that were located far from the street drain system used waste catchment vessels. They were fixed under the vertical toilet chute and had to be changed regularly. In case of permanently fixed vessels, the waste had to be removed regularly.

5.1.13 Mohenjo Daro outlook

A detailed investigation of Mohenjo Daro exhibits that the urban center is a complex type of social and political organisation. It is an elegant example of urban architecture, form, and planning. Jansen believed that the Indus people invented the use of vertical wells, use of toilets, covered drains, and city platforms (mud-brick platform) (Jansen, 1989). Vertical wells were unknown in Mesopotamian region. However, the use of mud bricks (for the construction of platforms) is a Mesopotamian architectural feature.

Possehl disagreed with Wheeler's paradigm of divisions of Upper and Lower towns incorporated with the people's rank or socio-political authorities. He also rejected that the ruling elites lived in the citadels (Possehl, 1998). His rejection was based on the fortification of Upper town, which suggests that the Upper mound was not effectively fortified. The western side of the great bath had a warehouse structure that was open to the Indus plains, and it cannot be observed from Lower town. The placement of granary thus makes no sense from a defensive point of view. He proposed that the placement of the warehouse was part of town planning and that it does not contribute to defence purposes.

Present topographical and archaeological analyses of Mohenjo Daro suggest that the division of the Upper and Lower towns was arbitrary; however, the structures of Upper town, such as the great bath, warehouse, granary, and pillared hall (priest's college), do not show an association with the presence of socio-political authorities. Rather, the structures of Upper town can be associated with performing some rituals or religious duties. However, the analysis by Sarcina of Lower Town provides excellent details about the types of building complexes. A majority of the houses were complex, having more than one room and a courtyard. The courtyard of every building was not directly accessible from the street, which is an interesting feature. That might indicate that they used courtyards for gatherings or meetings and that direct entrance from the street was limited. The courtyard could possibly have been used for craft production.

There is a clear difference between the architecture of the Upper and Lower divisions of the town. The most dominant features from the structural remains of Mohenjo Daro are ritual and craft production. This present analysis suggests that the city was a production and trade center. A community of people belonging to different occupations and social groups lived there. The scale of craft production and urban density is higher than in any other Indus city.

5.2 Harappa

Harappa is the second largest and extensively excavated settlement. Harappa settlement is mainly known because of its craft productions such as seals, figurines, jewellery, beads, large size and location. The Harappa site is located in Upper Punjab, Pakistan about 570 km from Mohenjo Daro. The settlement is located close to the dry bed of the Ravi. A large part of the town was removed before its discovery for getting bricks to build railway lines, and still several parts of the settlement are unexcavated. Present-day archaeological evidence is limited and gives only scattered and largely incomplete data, and unfortunately the details of the original settlement plan, architecture, and its size are not clear. However, it is estimated that during the urban period, the settlement spread over an approximately 150 ha area (Kenoyer, 1997). The site is considered the second most complex urban center of the Indus society.

Archaeological evidence from Harappa suggests that different parts of the settlement were occupied during different time periods, and the initial level of occupation started around 3800 BCE, which is known as the Ravi phase (Kenoyer, 1998). Settlement spread over three major mounds, and the excavated parts have been named AB, E, F, ET, R-37, and H as shown below in Figure 69. The archaeological evidence of the Harappa settlement presents the following features, which are discussed in table 5.

Settlement division	Upper town, Lower town
Structures	Circular platforms, workman's quarters, Granaries, furnaces
Architectural components	Drains, fortification wall, streets

Table 5. Studied components of Harappa

5.2.1 Setting

Harappa is located on the fertile alluvial plains of Upper Punjab. According to the global forest resource assessment, compiled by FAO in 2010, Pakistani Punjab is characterised by tropical desert. The site lies very close to the Ravi River and had substantial potential for agriculture production. The settlement is located 162 m above sea level, with an annual rainfall of around 278 mm. The average annual temperature is 24.9° C or 76.8° F. June is the warmest month with an average temperature of 34.9 C or 94 F. January is the lowest temperature month with an average of 12.6° C or 54.7° F.

5.2.2 Construction material

The construction material used for the Harappa settlement is primarily baked and mud bricks. Brick followed a standard ratio of 1:2:4 as shown in figure 61. It is evident that from all large settlements a standard ratio of bricks are discovered. Bricks in different sizes were produced, but with a standard ratio in relative size as shown in figure 68.

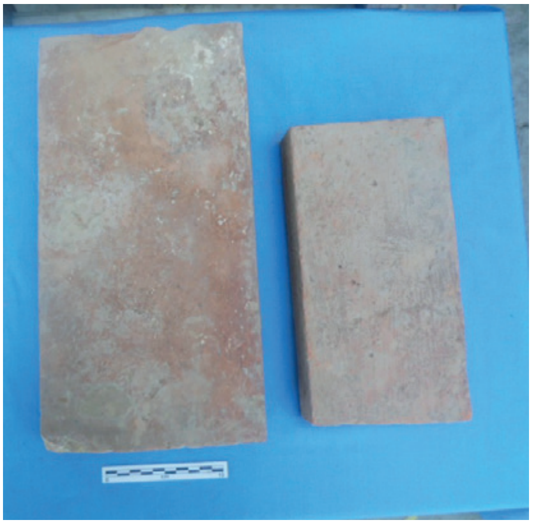


Figure 68. Two different sizes of baked bricks from Harappa but with a similar ratio of 1:2:4

5.2.3 Chronology

The chronology of the settlement is divided into the major periods; however, the urban period is divided into a further three subdivisions based on the rebuilding of city walls and site expansion, the changing in artefact styles, and the changing in the styles of seals (Kenoyer & Meadow, 2000).

Period 5	Post-urban	1800–1500 BCE
Period 4	Urban–post-urban transition	1900–1800 BCE
Period 3C	Urban	2200–1900 BCE
Period 3B	Urban	2450–2200 BCE
Period 3A	Pre-urban transition	2600–2450 BCE
Period 2	Pre-urban	3200–2600 BCE
Period 1	Pre-urban	3800–3200 BCE

Period 1 also known as the Ravi phase 3800-3200 BCE, during that period the settlement was a small village. The settlement was divided into two parts, which occupied the areas of Mound AB and Mound E. The structure of the settlement is not very clear, but two divisions suggested an early formation of Upper and Lower towns.

Period 2 is also known as the Early Harappan, or the Kot Diji phase. The cultural period of 2 was developed around 3200–2600 BCE, and it was defined by Mughal based on the artefact analysis and settlement pattern studies (Mughal, 1970). Early Harappan, or the Kot Diji phase, is considered the initial stage of urbanism in Indus society (Mughal, 1990). During the Kot Diji phase (Pre-urban around 3500 BCE), Harappa was 25 ha in size and was a major regional urban center, which interacted with the hinterland and obtained raw material from distant sources (Kenoyer, 1997). The settlement covered Mound AB, Mound E, and some parts of Mound ET. The settlement has an east-west and south-north planned layout of the houses and streets. They used mud bricks with a 1:2:4 ratio to build the houses, platforms, and walls. The settlements of Mound AB and Mound E have been delimited as using mud-brick walls, as discussed in figure 69(Kenoyer, 1991).

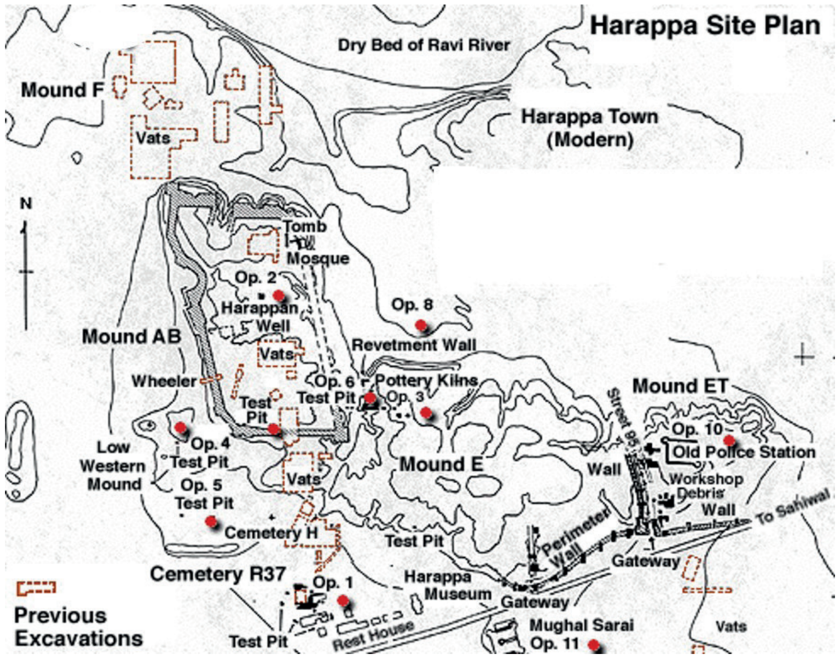


Figure 69. Remains of the Harappa settlement plan depicting some previous excavated parts and some test-pit points by Berkley's Harappa excavations project 1993–1995, Map source: Harappa.com (Kenoyer, 1991).

5.2.4 Built environment of Harappa

The western mound named AB is the central feature of the settlement and referred to as the citadel or Upper town. To the north of Mound AB, there is a hollowed belt of verdant crops, which marks an old bed of the Ravi (Wheeler, 1997). Nowadays, the Ravi flows about 10 km north of the settlement. Upper town is a parallelogram in plan and is fortified by a massive wall. The mound was measured as 420 m north-south and 196 m east-west. The mound is approximately 45–50 ft higher from the adjacent plain in a north-south direction, like Mohenjo Daro. A large part of this mound is currently occupied by a graveyard and has not been excavated.

Upper town in Harappa has a different pattern from Mohenjo Daro's Upper town. It does not contain any known structures associated with ritual performance, like a great bath, or any other structure associated with water. Furthermore, the fortification type of both settlements is different. Further, Harappa's Upper town is fortified by a massive brick wall, but Mohenjo Daro is fortified by a mud-brick platform. The most significant details of Harappa settlement are discussed in table 6.

Settlement plan	North-south
North-south measurement	420 m
East-west measurement	196 m
Height	4–5.6 m
Architecture	Fortified wall, mud-brick platform, traces of stairs

Table 6. Components of Harappa's Upper town

Mound AB has a raised platform of mud bricks 2–2.6 m above ground level and is surrounded by a defensive wall. The wall is 4 m wide at the base and tapers upward (Wheeler, 1997). The wall is constructed of mud bricks, but baked bricks were used for on the external revetment that is 0.34 m wide. There are rectangular bastions at regular intervals, and some of them appear to rise from wall level. The wall is followed by the main entrance to the north, represented by a marked inlet (not fully explored though). Towards the west, the wall is occupied by a curved re-entrant controlled by a bastion, which leads to the extra-mural ramps and terraces, which are approached by a gate and might have been supervised by guardrooms. At the south of the wall, there is a flight of stairs leading to the citadel.[3] There is no evidence of any significant structural remains on this part.

5.2.5 Mound E and ET

Mound E is situated south of Mound AB. Only some parts of this mound have been excavated, which present the remains of an outer city wall (Meadow & Kenoyer , 1997). The southeastern corner of Mound E has a massive baked bricks gateway and drain complex. This complex includes sewage drain, gateway and side rooms. The drain was a large corbelled culvert that was built in the middle of the gate. The entrance street through the main gate was approximately 2.6 m wide that runs towards north alongside perimeter wall of Mound E (Meadow & Kenoyer , 1997).

Mound ET is occupied with a present-day police station; however, the remaining wall continues to this section. Further details are not available for this section.

5.2.6 Mound F

Mound F is located 91 m north of Mound AB. This part of the settlement has fewer architectural remains and is about 4 ft high, constructed on a podium of rammed mud, and in an east-west direction. The most elaborated architecture that remains is a group of 12 rectangular structures known as granaries. The earliest level of the granary structures dates back to 2450 BCE. They are arranged symmetrically in two rows shown in figure 70. Each row consists of six granaries. Every structure has a small chamber adjoining three sleeper walls to each unit. The central sleeper wall consists of rectangular thickening to carry additional roof support. The function of the sleeper wall is to intervene the air ducts to keep the building dry and to prevent moisture. The central passage of both rows is 2 m wide. The floor space of these granaries is approximately 836 m^2 (Wheeler, 1997).

Special structures	12 Granaries
Shape	Rectangular
Arranged by	2 rows, 6 each row
Distance between the rows	2 m

Table 7. Mound F, Granary structures

Mound F also has some buildings of double range structures, and five rows of circular working platforms have been discovered within that part. The building structures are small 15 x 6 m long rooms (Wheeler, 1997). All rooms have three raised platforms at the end of the room. These dwellings functioned as houses that were separated by approximately 1 m lanes. They were accessed through an oblique passage to secure privacy. Very close to these structures are 16 pear-shaped furnaces, which were discovered

3 Sir Alexander Cunningham has observed the flights of stairs on both sides, eastern and western, but these flights of stairs are no longer available and may be subject of brick robes. For more details, see Archaeological survey of India reports 1872 volume 3, PP. 106

Figure 70. Granary structures, Photo from Harappa.com

Figure 71. Double range structures, Photo from Harappa.com

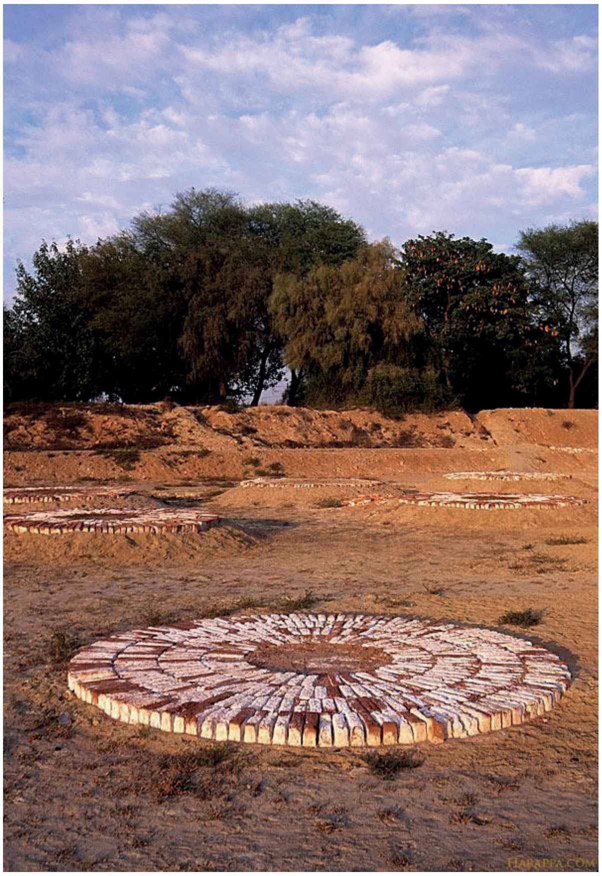


FIGURE 72. Working circular platform of Harappa, Photo from Harappa.com

on a slightly higher level. These furnaces were used for melting bronze[4] and processing raw materials. These rooms are often suggested as being workman's quarters (Kenoyer, 1998). Moreover, the architecture of these houses or quarters is less complex than Mohenjo Daro's private architecture. The buildings at Mohenjo Daro have several rooms and courtyards; however, Harappa's architectural complexes are less dense compared to Mohenjo Daro's.

To the north of these structures, there is a medley of broken walls and disturbed floors, which presents inappropriate planning of the town. Among these spaces, there are 18 circular platforms arranged in 5 rows. They were built using four concentric rings of brick on edge with the fragment of a fifth with a central hole shown in figure 72. Each platform has a 3.35 m diameter and is situated at a distance of 6.4 m center to center (Wheeler, 1946). The central hole contained husks or straws, burnt wheat, and husked barley, which suggests that the platform might have been used for pounding or grinding grain.

Circular platform	18
Diameter	3.35 m
Distance center to center	21 ft
Arranged by	5 rows

TABLE 8. Circular platforms of Harappa

5.2.7 Cemeteries of Harappa

To the west of Mound AB, there are the remains of two cemeteries known as Cemetery H (named because of its mound) and Cemetery R-37 (named because of its excavation square). Cemetery R-37 has the most extended area and is considered the largest cemetery of the urban period. Cemetery H is located at the southern end of Mound AB and is associated with the post-urban period 1900–1500 BCE.

Cemetery R-37 is composed of urban period graves from 2150–2450 BCE. The overall area of this cemetery is larger than 50 x 50 m (Possehl, 2002). A total of 209 skeletons have been discovered at that cemetery. The graves show different burial practices. In some graves, the deceased were placed in a grave pit with a north-south orientation, some contained wooden coffins, some were lined with bricks, and some have supine bodies. The ritual of offerings was a common feature during this period, as most of the bodies have pottery, ornaments, and copper artefacts along with them.

4 For more details see M. S. Vats Excavation at Harappa 1940 p,470

There is another area that have human remains known as area G. Area G is located in a low lying field southeast of the city wall. Area G sorrounds Mound E. This area was excavated by Vats because he was interested in the lifestyle and behaviour of the people who lived outside city gate (Vats, 1940). Vats excavated 140 foot trench north to south and discovered osseous remains consisted of twenty isolated human carnia, a collection of human long bones, three human mandibles, two partial vertebral columns, a scapula, a canine vertebral column and one intact burial located in the southeast corner of the excavated trench. The human remains from Area G present deviant type burials. All human remains were parts of 23 human bodies consist of 12 adults and 9 subadults. The isolated crania, vertebral column and articulated leg bones indicate that decomposition occurred somewhere else (Schug, 2017).

5.2.8 Harappa outlook

The present analyses have suggested that the scale and settlement type of Harappa is different from Mohenjo Daro settlement. The Harappa settlement is geographically and architecturally very different from Mohenjo Daro. The fundamental difference between both settlements is city planning. Mohenjo Daro was deliberately planned; however, the Harappa Urban center was gradually developed from a small rural settlement. The irregular planning of the city is likely from the gradual development of the settlement. Major structural differences can be seen in some of the basic components, such as a city plan, fortification, sewerage system, and private architecture. The settlement does not present a strategically good plan compared to Mohenjo Daro. The settlement's plan exhibits a slow gradual development of the settlement. Most elaborate structures, such as circular platforms, fortification, and streets, were built/added during the urban period. These added architectural features were infused on the original rural settlement. However, the circular platforms and the fortification wall are distinctive features of Harappa that are taken away at Mohenjo Daro settlement. The fortification of Harappa is an elaborative feature of socio-political and economic strategy and differs from Mohenjo Daro. A massive city wall similar to Harappa's is missing at Mohenjo Daro settlement, as discussed in the above section.

Another distinctive feature of Harappa is its division of two settlements at an earlier stage of the city. The settlement presents some major Indus period technology, industry, and long distance trade links that could have played a crucial role in the socio-economic infrastructure of the society.

5.3 Dholavira

The Dholavira settlement is located in the Kutch district in the north-south corner of Kadir Island, Gujarat, India. It is one of the among five largest known and excavated urban settlements that covered approximately 60 ha (Bisht, 2000). Dholavira is a planned coastal settlement of the Indus society. The chronological studies of Dholavira suggested that it was constructed around 2650 BCE. Some of its elaborative and distinct architectural features are described in table 9 and discuss below.

Settlement division	Upper Town, Middle Town, Lower Town
Structures	Palace, houses, workshops
Architectural components	Water reservoirs, palace

Table 9. Studied components of the Dholavira settlement

5.3.1 Setting

Dholavira is located in a desert environment, and there is no major river close by, unlike other Indus cities. The environmental conditions are semi-arid. Two seasonal streams run from north to south of

Dholavira and are named Manhar and Mansar. Both streams originate in the northeast from the hills, flow in defined beds, and join each other before running into the Runn of Kutch. Both streams are seasonal and have the capacity to hold a high volume of water after a downpour in the catchment area, but they also have the capacity to dry up quickly within a few hours (Bisht, 1994). Most parts of the Runn of Kutch are rocky terrain and seasonal streams. Forests cover the hills, and it has a sloping landscape.

The Runn of Kutch is also known for its poor rainfall, only 262 mm received annually from monsoon rains. The monsoons usually occur from June to August or September. Sometimes the area is subject to famines due to a lack of rain for three or more consecutive years, And in such circumstances people migrate to other places.

5.3.2 Chronology

The chronology of Dholavira is divided into 7 different developmental stages serially numbered from I to VII. The cultural stages document a gradual rise, culmination and fall of the urban system at the Dholavira settlement (Bisht, 1994). The earliest level of the city suggests that the city was constructed around 2650 BCE. The settlement's decline started around 1850 BCE and lasted until 1450 BCE. The 7 developmental stages correspond to different time periods as shown in the following chart.

Stage	Period	Date
Stage VII	Post-urban B	1650–1450 BCE
Stage VI	Post-urban A	1850–1750 BCE
Stage V	Urban C	2000–1900 BCE
Stage IV	Urban B	2500–2000 BCE
Stage III	Urban A	2500–2200 BCE
Stage II	Pre-urban to urban transition B	2550–2500 BCE
Stage I	Pre-urban to urban transition A	2650–2550 BCE

5.3.3 Built environment of Dholavira

The built environment of the Dholavira settlement was precisely proportionate following a set of principles of planners and architects with mathematical precision or may be astronomical established orientation. The settlement plan is rectilinear in shape and divided into three major divisions, known as Upper town, Middle town, and Lower town discussed in figure 73.

These three divisions are precisely constructed with mathematical ratio. The structures and ratios are described in table 10.

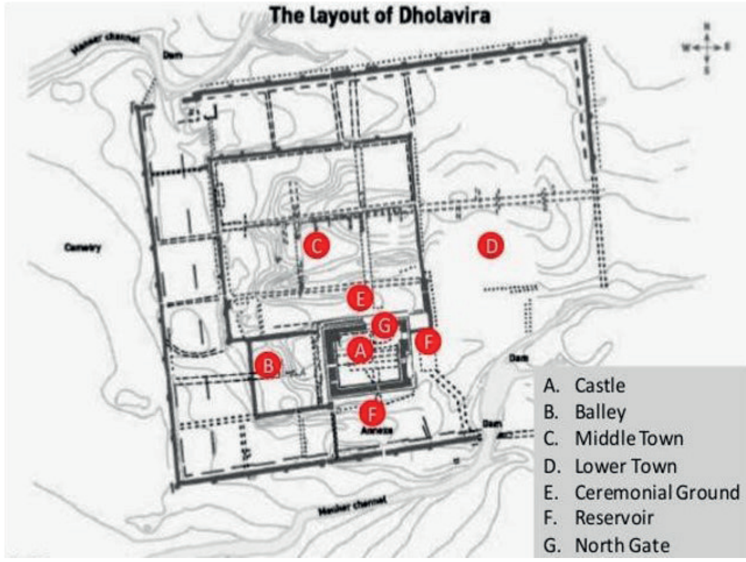


FIGURE 73. Ground plan of Dholavira, Map source: ASI (Archaeological survey of India)

No	Division	Width	Length	Ratio
1	City, Internal	616,87	711,10	4:5
2	Castle	92	114	4:5
3	Castle	118	151	4:5
4	Citadel	140	280	1:2
5	Bailey, Internal	120	120	1:1
6	Middle town, Stadium, Internal	290,45	240,5	6:7
7	Middle town without stadium, Internal	242	240,5	5:7
8	Stadium, Internal	47.5	283	1:6
9	Lower town built up area	300	300	1:1

TABLE 10. Dholavira architectural details (Bisht, 2015)

The earliest levels of the city were on a smaller settlement with a fortified citadel only. Around 2500 BCE, the settlement started to grow in size with the introduction of advanced architectural transformations and a water management system, discussed below.

5.3.4 Fortification wall and gates

The settlement of Dholavira had a thick wall around the settlement. The wall runs for a length of 781 m along the east west on the north and 630.50 m along the north south on the west. The southern arm is traceable for a distance of about 600 m and the eastern one for 210 m with a vague indication for another 100 m. in the east, the ground being higher and more vulnerable to surface water and wind action. The eastern wall and half of the northern wall had suffered considerably to the extent of being obliterated for stretches. In the south-eastern quarter, the wall is not traceable now. Another interesting feature is the provision of salient projection almost at regular intervals. There are 11 salients along the northern and 9 along the western arm of the city-wall, roughly at a distance of 50 to 52 m (Bisht, 2015). There were 5 salients along the northern and 4 along the western arms of the middle town. The wall functioned as a fortification wall that remained in use from the urban to post urban period during 2500-1450 BCE.

The castle of Dholavira settlement is entered through five gates that are pierced through the fortification. Each gate has a distinct design. The eastern arm has two gates; there was one in each of the remaining three walls.

The south gate has a concealed passageway with an ordinary doorway. It is connected to a flight of wide steps descending to the northern embankment of the rock-cut reservoir.

The western gate was used to intercommunicate with the bailey. This gate has a 9 m long and 2.2 m wide passageway with a small guard room carved in the southern wall. The passageway has a few steps made of large limestone slabs.

To the eastern side, there are two gates. The East Gate 1 has a large chamber consisting of an elevated side-chamber on the south and a collateral sunken passageway on the north. The passageway is connected to a flight of 14 steps at the inner end while it was fitted with a doorsill made of large lime stones slabs at the outer end.

The East Gate 2 is provided with a series of broad steps going down from the top but terminating higher up on the outer edge of the defensive wall without yielding any evidence of descending to the ground level on the east.

The north gate commanded over the stadium, the middle town, and the Lower town. It consisted of two elevated chambers flanked by a sunken passageway.

5.3.5 Upper Town or Castle and Bailey

Upper town is divided into two structures known as Castle and Bailey and measures 280 x 140 m. The structures were named Castle and Bailey because their plan resembles European castles having two well-fortified areas called the inner and outer baileys. The Castle is located to the south, and Bailey, or the annex, is located to the west. The structures of the annex are the workshops for the people who work in Upper Town.

The south-western corner of the castle has some special architectural features associated with water structures such as a large well, two water tanks, and drains. The diameter of the well is 4.25 m in the north-south direction and 4 m along the east-west. The depth of the well is 13.60 m (Bisht, 2015). There are two tanks connected with the well through drains and fed by the water drawn from the well. These water tanks are smaller than the water tank of Mohenjo Daro, but might be used for bathing or religious rituals.

To the east and south of the castle structure, there are two large water reservoirs. The eastern reservoir can be approached using a 31-step staircase from the castle. The reservoir is 24 m wide and 5 to 7.5 m deep. The southern reservoir is 95 m long, 10 m wide, and 2.4 m deep. To the north, the reservoir opens in the ground and may have been used for ceremonial or occasional meetings (Bisht, 2000). The citadel along with Bailey were fortified constructions with stone walls as discussed above.

5.3.6 Middle and Lower Town

The second division of the city is known as Middle Town, which measures 340 by 290 m. This division has its own fortification wall. To the north of Middle Town, or second division, there is a ceremonial ground. Middle Town has residential areas followed by streets, lanes, and drains. There are two types of streets that run through Middle Town known as peripheral streets and arterial streets. The peripheral streets run along the eastern defensive wall and have a width of approximately 4.7 m. The arterial streets run across axially from west to east dividing the residential units into two equal halves. The width of the arterial street is from 4.35 to 5.30 m. The arterial and peripheral streets are further divided into sub streets that are generally less than 4 m in width (approx. 3.15-3.50 m) (Bisht, 2000). In total 14 small streets were discovered of varied width, among them six streets are branched off from E-W Arterial Street and eight branches from N-S running off Arterial Street, thus dividing the whole area into various housing blocks.

There are some narrow lanes which are generally seen between the various housing blocks and probably used as an intra-communication way between various housing blocks. The width of lanes is from 1.2 m to 1.7 m.

The streets are flanked on both sides with houses. The houses are rectilinear in shape. There are seventeen small and big housing blocks discovered. Housing blocks differ in their sizes; the smallest housing block measures 8.10 meters, while the largest housing block is of 65.35 meters area (Bisht, 2000).

The rooms of these houses have large and broad walls with nice, regular, and occasionally paved floors.

Building materials included stone cut and mud bricks with the size of 40:20:10 cm, bricks that are the typical Harappan brick ratio (1:2:4). There are some platform-type structures outside each home encroaching the street pattern, thus resulting in a decrease in the actual width of the street. The actual purpose is yet to be confirmed, but most likely either used for sitting, entertainment or for selling goods (market).

Further down to Middle town, there is a third division known as Lower town. Lower town doesn't have its own fortification. Lower town measures 300 x 300 m. Both divisions of the town were planned on semi-grid patterns, like Mohenjo Daro. In Lower town, there is no evidence of street drains.

5.3.7 Water management

Dholavira's special feature is its water management system. There is a seasonal stream that runs north to south of the site and evidence of several dams once in it. These dams or bunds allowed Dholavira s inhabitants to modify and create water routes to irrigate fields.

The city itself has 16 reservoirs inside the fortification wall, which were used for rainwater collection (Bisht, 2015). Upper town, or the castle, has several drains and catchments connected to the water reservoirs. The periphery area of the reservoirs is fields, and the water from the reservoirs was directly used for irrigation purposes.

5.3.8 Material

Dholavira was built up with cut stones instead of baked bricks and sun dried mud bricks, which is a distinct feature of this settlement.

5.3.9 Dholavira outlook

Dholavira is a special case of Indus culture. It shared the cultural ideology of Indus culture, but its location and construction materials are very different from other cities. The construction materials and water reservoirs of the city emphasize how the environment can affect urban forms and the planning of a city. A special architectural feature, named the Palace, makes it a significant urban city. There is no other palace-like structure at other urban centers.

5.4 Ganweriwala

The Ganweriwala settlement is considered the 5th largest urban center of Indus society (Mughal, 1997; Possehl, 2002; Wright, 2010). The settlement is least known and has a limited history of explorations as discussed in 3.2.4. However, the topography, size, environment, and artefacts shown in table 11 are discuss below to analyse the settlement's socio-economic and cultural scale.

Settlement division	Upper town, Lower town
Structures	Artefact clusters
Architectural components	Not excavated (baked bricks are found)

Table 11. Studied components of Ganweriwala settlement

5.4.1 Setting

Ganweriwala site is situated in the Cholistan desert located in the south of the province of Punjab, Pakistan. Cholistan is an extension of the great Indian Thar desert, bordering the Bikaner and Jaisalmer districts of the Indian state of Rajasthan. The western fringes of the Thar desert are defined by the dry bed of the Hakra River known as the Hakra Depression. The dry bed of the Hakra River runs along the western fringes of the Thar desert, turns south to the eastern Sindh, and then travels farther down to the Runn of Kutch.

The total area of the Cholistan region is approximately 15,902 km^2 which is purely desert and locally known as Rohi. The northwestern area of the Cholistan is flat with low sand dunes, known as Lesser Cholistan. The south and southwestern parts have sand dunes that rise to gradual height, in some places, of about 152 m, and it is known as the greater desert. Ganweriwala settlement is located in Lesser Cholistan, about 28 km west of the 9th century AD Derawar Fort (Mughal, 1997).

The climate of the region is arid. Rainfall is quite unreliable, with a maximum annual average of 137 mm, and July to August are the wettest months. The temperature during peak summer season rises approximately up to 51°Celsius and drops to the freezing point during the month of January.

5.4.2 Topography

Results from present analyses show that Ganweriwala settlement consists of two closely situated large mounds. One of these mounds is rectangular, while the second one is oblong in shape. Both mounds cover an area of approximately 67 ha as discussed in chapter 4.

Present day, the mounds covered scarce vegetation and desert bushes. The morphology of the mounds suggested that the settlement had a grid plan, like other cities, and is divided into two major divisions: arbitrarily called an Upper and Lower town shown in figure 74. Both divisions have an approximate distance of 50 m, followed by a Lower depression. This feature has been observed in the Mohenjo Daro settlement as well.

Another topographical study has suggested that house blocks are running parallel to each other, followed by depressions among them. The depressions seem to be streets or open spaces intersecting each other at right angles (Masih, 2018). In this study, a road cut section of Ganweriwala settlement with a 90 cm wide mud-brick wall running in a north-south direction is also presented, which is shown in figure 75. In order to reach a final conclusion about whether these settlements resemble other Indus settlements or not, detailed excavations of this site are required. But artefact study from the surface suggested that the people of Ganweriwala had similar socio-cultural and economic practices like other major settlements.

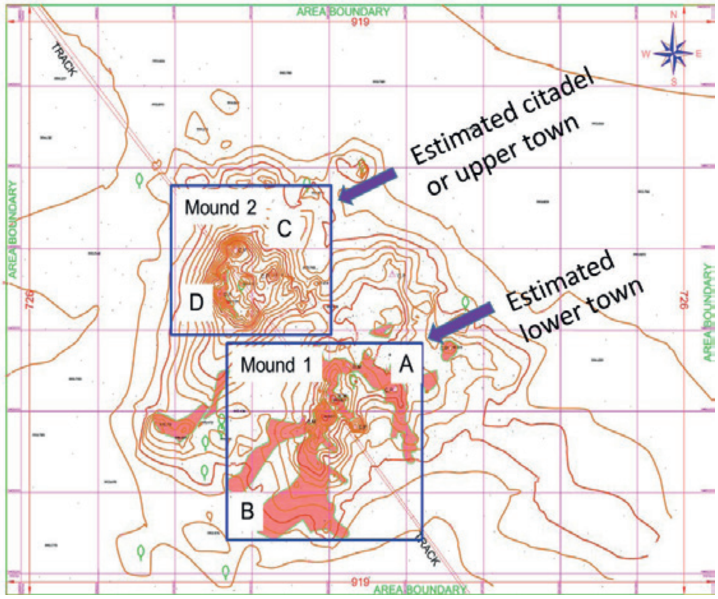


Figure 74. Ganweriwala topographic map. The green border shows the surveyed area and site boundary. Orange-coloured parts of the site show the highest density of artefact spread on the surface.

Figure 75. Ganweriwala road cut section, Photo from Harappa.com

5.4.3 Chronology based on artefacts

At present, it's hard to draw conclusions about site chronology due to the lack of data and analyses on artefacts. To the best of the author's knowledge, only one study has been reported so far about an analysis of the artefacts (Masih, 2018). In that paper, carbon dating analysis was presented on selected artefacts, which suggest that the Upper level of the settlement was occupied during 2300–1900 BCE (Masih, 2018). The results suggest that the settlement was occupied around 3800 BCE. It gradually developed into a larger settlement, and around 1900 BCE, human occupation ended.

Period	Phase	Date
Period 4	Post-urban	2000–1900 BCE
Period 3	Urban	2600–1900 BCE
Period 2	Pre-urban	3200–2600 BCE
Period 1	Pre-urban	3800–3300 BCE

Ganweriwala Tentative chronological scheme based on a ceramics analysis

5.4.4 Material culture

Ganweriwala contains vital cultural materials, such as fired bricks, wedge-shaped bricks used in wells, copper tools, households, stone tools, steatite-disc beads, agate beads, ceramics, bangles, toys, clay tablets, copper seals, unicorns, and fan-headed female figurines. The cultural materials from Ganweriwala settlement reflect a greater similarity with the materials discovered in other urban centers, such as types of vessels, designs, standardisation, and writing (Gulzar & Parpola, 2016). Notable features of similarity are the iconographic motifs such as unicorns, fan-headed females, and a yogi-positioned deity depicted in a clay tablet shown in figure 76.

Figure 76. Yogi-positioned deity on a clay tablet from Ganweriwala

The clay tablet shown in figure 76 was discovered in 2007 by Masih and his colleagues. It presents a human seated on a throne in a yoga pose. Behind the throne there is a depiction of a deity. The body of the deity looks like a human, but on the head, it has ears like an animal. These type of symbols and clay tablets have been discovered from other settlements that reflect similar socio- cultural practices.

5.4.5 Ganweriwala outlook

The lack of excavations of Ganweriwala and the limited data about the settlement restrict from drawing a final conclusion about architectural structures. The details of topography, environment, and cultural material can be included for comparison with other settlements. However, present analysis provides an approximate socio-economic and cultural scale of settlement that may vary with future excavations.

5.5 Rakhigarhi

Rakhigarhi is located in the Haryana district, Punjab, India, and it is located 150 km away from modern New Delhi. The settlement was discovered and excavated in 1964; however, several parts of the settlement are still unexcavated, and knowledge about the settlement plan is limited (Bhan, 1975). The site mainly consists of seven irregular mounds and occupies a large area. In the initial reports, the size of the complete site was estimated to be around 60 ha. A recent exploration, however, claims that the site is much larger than the information reported earlier (Shinde, 2018).

The site was consistently occupied during the pre-urban period. Mounds RGR-1, RGR-2, and RGR-6 represent habitational areas with a continuous occupation from pre-urban to the urban period. RGR-7 is a necropolis (Nath, 2001).

Settlement division	Not clear
Structures	Graves
Architectural components	Houses, drains

Table 12. Studied components of the Rakhigarhi settlement

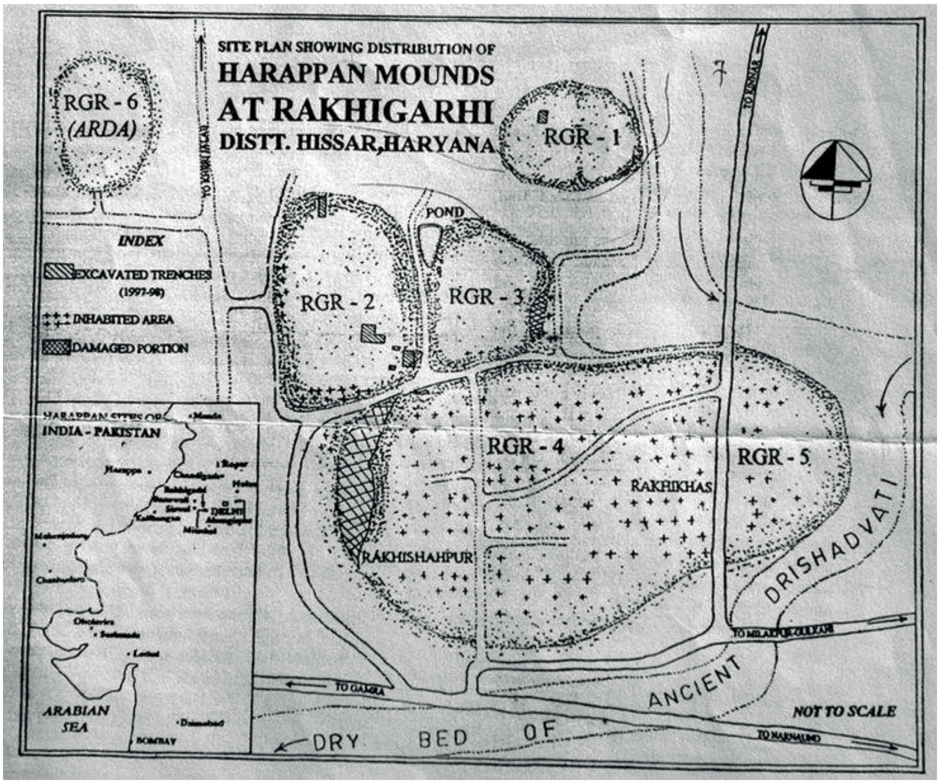


Figure 77. Rakhigarhi site plan, Photo from ASI (Archaeological Survey of India)

5.5.1 Setting

Rakhigarhi is located in the fertile agricultural plains of Haryana. Hrayan, Punjab is one of the major divisions of the northern Indian plains. Haryana stands out as a riverless tract spread between Yamuna and Sutlej. To the north, it is associated with the bank of Drishadvati[5]. The climate of the region is tropical desert with an annual rainfall of 395 mm.

5.5.2 Built environment of Rakhigarhi

The chronological studies of the Rakhigarhi settlement have suggested that the settlement was occupied during the pre-urban period around 3200 BCE, and it gradually developed from a village-like settlement. But a few Hakra ware ceramics were also discovered which suggests an earlier developmental stage at around 3800 BCE.

A contour map of Rakhigarhi suggests seven different parts of the settlement, which were named RKG-1, RKG-2, RKG-3, RKG-4, RKG-5, RKG-6, RKG-7. According to Possehl, different parts of the settlement belong to different cultural traditions: RKG-6, for example, is a Sothi-Siswal cultural settlement. The Sothi-Siswal phase is a special culture that developed along the Sarasvati River in India from 3200 to 2700 BCE, which was contemporaneous with the pre-urban period (Possehl, 2002).

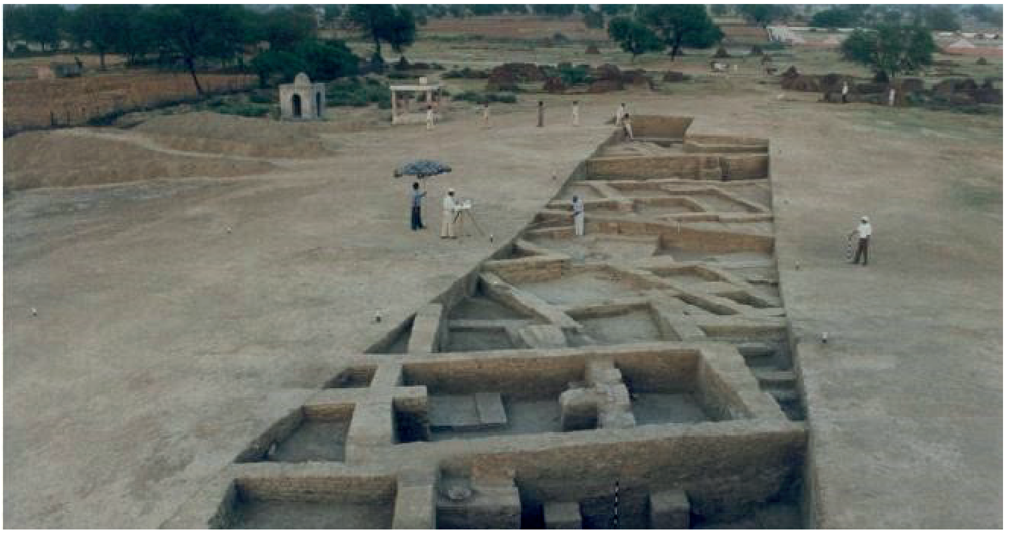


Figure 78. Architectural structures from Rakhigarhi,Photo from ASI (Archaeological survey of India)

The excavations at the Rakhigarhi settlement provided limited details about settlement plan and architecture. Excavated remains consist of rectilinear structures which suggest houses with a cardinal direction. A street drain has been found connected to a house drain; however, there is no evidence of a water management system, as in Mohenjo Daro. The city plan is also not clear and does not exhibit Upper and Lower town divisions, which is an important feature of Indus cities. The settlement was constructed with baked and mud bricks; however, the standardisation is not similar to large urban centers. The bricks were made with a 1:2:3 ratio, which is a pre-urban ratio. Evidence from Mohenjo Daro, Harappa, and Ganweriwala centers suggest that in around 2600 BCE they adopted the 1:2:4 standard ratio of baked bricks.

The most notable archaeological evidence is a cemetery that belongs to the urban period. The burials were discovered in the RGH-7 mound, which is further divided into three parts. The total cemetery covers an approximately 1 ha area (Shinde et al., 2018). The RGH-7.2 part was excavated using two main trenches known as A1 and A2, which have 6 and 36 burials, respectively. To the south of RGH-

5 Rigvedic river for details see Dr Amarendra Nath´s Rakhigarhi excavation report (1997–98 and 1999–2000) by Archaeological survey of India pp. 9–13

7.2, the other part is RGH-7.3, which has 11 burials. A total of 53 human skeletons were discovered. Burials were divided into two main types, known as primary and secondary burials (Shinde et al., 2018). Primary burials are rectangular pits with vertical cuts and a flat bottom. That type of burial has the bodies of full skeletons. The secondary burial types are oval and square in shape, and they have scattered bone remains. The bodies from the primary burials were facing toward the north and buried with pottery, jewellery, and household items.

5.5.53 Rakhigarhi outlook

Rakhigarhi is an important urban center of Indus society and is the second largest settlement located on the Ghaggar-Hakra River system. Ganweriwala and Rakhigarhi both developed at the bank of the Ghaggar-Hakra River system. Future research on both the settlements will provide promising new evidence about both the sites. The architecture and settlement plan are not comparable with the Mohenjo Daro. However, the housing structures exhibit a density similar to those in Mohenjo Daro. The settlement also has burials with burial practices similar to the Harappa cemetery R-37. The Rakhigarhi settlement is the second largest settlement for which burials have been reported. There is no evidence of burials within Mohenjo Daro.

CHAPTER 6

Mineralogical analysis and provenance of artefacts from Mohenjo Daro, Harappa and Ganweriwala Settlements

This chapter aims to examine the standardization among selected artefacts of Mohenjo Daro, Harappa, and Ganweriwala settlements. Artefacts from these three large settlements are analyzed to look at the mineral assemblage and production techniques such as firing temperatures. The results are compared and provide an approximate value of similarity and differences among artefacts from different settlements.

6.1 Introduction

The aim of this chapter is to examine the similarities and differences of the clay paste of pots and production techniques of everyday used utensils from three settlements named Mohenjo Daro, Harappa, and Ganweriwala by using SEM-EDX analysis. I have selected the artefacts belonging to the Group 1 artefacts (cooking and processing potsherds) discussed in chapter 5. Cooking and processing belongs to extensively and commonly used household objects that can better reflect upon the socio-economic and cultural practices among people of different settlements.

The results of the following analysis reflect upon the interaction and standardization of production technology among three different settlements. However, the analysis is performed on limited artefacts and provides preliminary results.

Ancient pottery or artefacts from the Indus settlements has been extensively studied. During earlier excavations, Indus pottery was analyzed through traditional approaches to define different types and styles of the artefacts (Dales & Kenoyer, 1986). Most of the artefacts were taken into account for morphological studies such as macroscopic assessment, vessel forms, surface features and decorative motifs that have been presented in excavation reports (Majumdar, 1934). A well known publication is by Mackay for the analysis of Mohenjo Daro and Chanhu Daro pottery. He studies macroscopic features of pottery including the study of pastes, dimensions, decorations and frequency of occurrence (Mackay, 1943). Earliest geochemical analysis were performed on pottery from Harappa and Mohenjo Daro and laid the foundation for subsequent studies on raw materials, slips and decorations (Dales & Kenoyer, 1986). Most of the studies focused on the pottery from two major settlements Mohenjo Daro and Harappa. In 1960s analytical methods were used to study metallurgical slags and production of copper artefacts from Ahar, Rajasthan (Ceccarelli & Petrie , 2018). However, there are no any large scale analysis that used to compare the results from different settlements.

6.2 Material and methods

A total of 9 artefacts have been analyzed for the present study. 3 artefacts from the Mohenjo Daro settlement, 3 artefacts from the Harappa settlement, and 3 artefacts from Ganweriwala settlement. These artefacts are randomly collected and taken from the Mohenjo Daro Museum, the Harappa

Museum, and the Lahore fort museum. 3 Samples from the Mohenjo Daro settlement are named as MHJ 1, MHJ 2, MHJ 3.

MHJ 1/M1 is a body sherd of a pot with black on red fabric. Black paint is visible but the motif is not clear. It seems like a vertical band around the pot.

MHJ 2/M2 belongs to a perforated pot with a plain surface.

MHJ/M3 is a piece of a bangle. The artefacts are shown in figure 79.

FIGURE 79. Artefacts from Mohenjo Daro

3 Samples from the Harappa named HRP 1, HRP 2, HRP 3. HRP 1 belongs to a perforated jar.

HRP 2 belongs to a pot with black on red fabric. The sample contains a vertical black painted band on the surface.

HRP 3 belongs to a household pot with plain surface. These artefacts are shown in figure 80.

FIGURE 80. Artefacts from Harappa

3 samples from Ganweriwala settlement named GNW 1, GNW 2, GNW 3.

GNW1 is the neck of a jar with a plain surface. GNW2 belongs to a perforated pot. GNW 3 is a base of a pot with a nails impression. Artefacts shown in figure 81.

The X-ray energy emitted and the electrons strike a solid specimen enable to identify the main elements that were present in the pottery sample (Krapukaityte, et al., 2006). The method is very useful to define the pottery of a particular area and people by studying the composition of the raw materials used. It can be used to get information about the type of clay minerals used in the pottery i.e., to check the calcareous/ non-calcareous and either low or high refractory as well as to the firing atmosphere adopted by the artisans at the time of manufacture. The content of calcium oxide (Ca) is used to know about the calcareous or non-calcareous nature of the material. The clays containing an amount of Ca greater than 6% are known

Figure 81. Artefacts from Ganweriwala

as calcareous clays and with Ca less than 6% as non-calcareous clays as investigated by Maniatis and Tite (Maniatis & Tite, 1981). If the content of other minerals such as K, Fe, Ca, Mg and Ti are greater than 9%, the clays are classified as low refractory clays. The atmospheric condition during firing of artifacts can also be identified by knowing the concentration of magnetite and hematite in the samples.

The digital microphotographs of the pottery samples were taken using SEM model JEOL JSM-5600 and stored on the computer window 95 platform. The resolution of the SEM is 3.5 nm with a maximum possible magnification 3,000,000x. The imaging was taken by setting up the equipment at a magnification of 1000x and 2500x. The tungsten filament was used as an electron source at accelerating voltages from 0.5 to 30 kV. The elemental analysis was carried out using the EDX system. From the three analysis modes available on the EDX system, spectral analysis was used in the present work. Both of the above described instruments were used from the University of Agriculture Faisalabad, Pakistan.

6.3 Results and discussion

6.3.1 Mohenjo Daro

The EDX results of artefacts from the Mohenjo Daro settlement show that the compositional elements of the three pots are different. The results elaborate that the raw material from these pots was collected from three different locations as shown below and compared in table 14.

Element	Symbol	Atomic number	MHJ 1	MHJ 2	MHJ 3
Carbon	C	6	36.65	0	13.31
Sodium	Na	11	10.30	2.27	25.31
Silicon	Si	14	13.22	36.03	11.74
Aluminium	Al	13	6.90	16.18	5.77
Calcium	Ca	20	9.63	20.50	3.10
Sulfur	S	16	6.48	0	3.29
Chlorine	Cl	17	4.43	0	31.07
Iron	Fe	26	6.42	12.97	3.16
Magnesium	Mg	12	2.14	4.14	1.19
Pottasium	K	19	3.83	6.69	2.05
Titanium	T	22	0	1.21	0

Table 13. Mineral assemblage of Mohenjo Daro artefacts

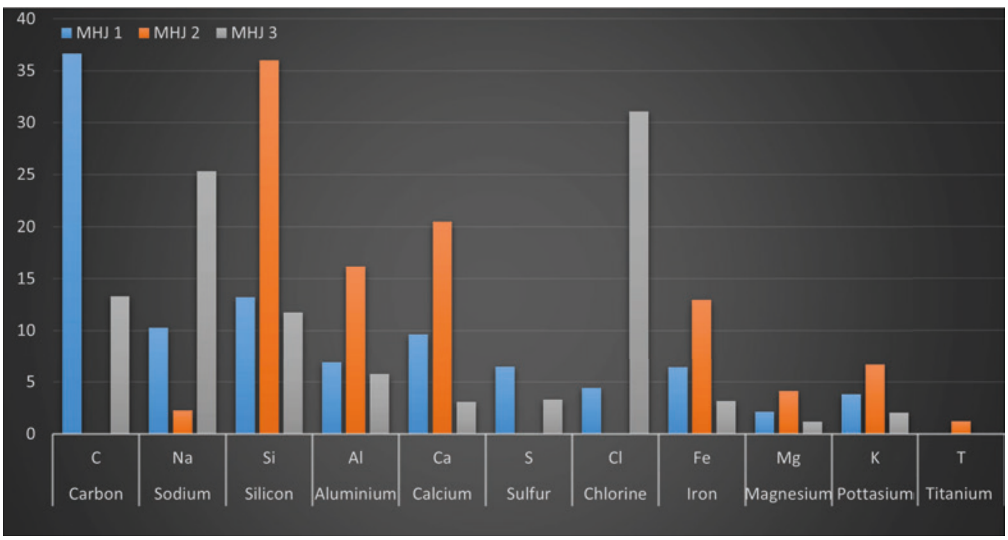


Table 14. Comparison of mineral assemblage of three artefacts

The major constituents are Si, Fe, Ca, Al, and Ti. The composition of Fe (Iron) and Ca (Calcium) determines the firing temperature and nature of the clay minerals. The clay minerals of MHJ 1 and MHJ 2 are calcareous although MHJ 3 is non-calcareous as discussed in 6.2. The amount of fluxes (K, Fe, Mg, Ti) in MHJ 1 and MHJ 3 are lower than 9% indicating that the nature of clay is highly refractory. The fluxes (K, Mg, Ti) in MHJ 2 are also lower than 9 %. Only Fe is 12.97 but collective fluxes suggest a high refractory clay as well (Maniatis and Tite, 1981). The SEM micrograph results of three potsherds shows that 3 potsherds have different internal morphology as shown in figure 82.

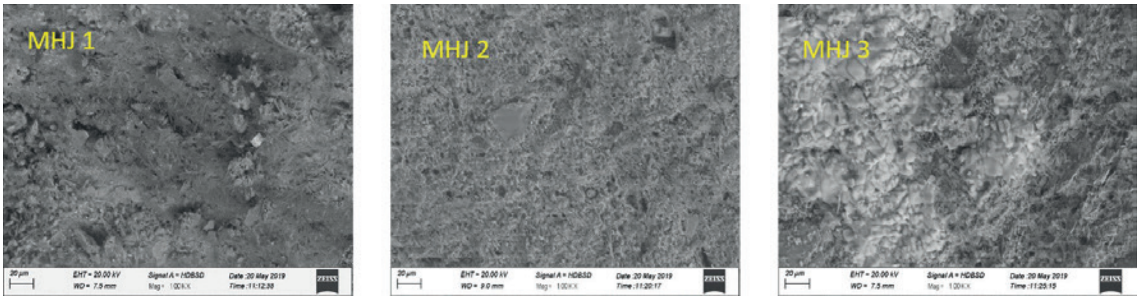


FIGURE 82. SEM images of Mohenjo Daro artefacts

The micrographs give a clear view of internal densification of artefacts. This densification is used to analyze the technology used for making ceramics (Krapukaityte, et al., 2006). For example MJH 1, image shows the presence of microfilament or rod like structures that might be added to anti plastics or can be carbon. MHJ 2 is porous and elements are clearly visible. Both MHJ 1 and MJH 2 seem to be fired at low temperatures less than 800 °C. Although MHJ 3 shows a mix of a porous structure with rod like microfilaments at some points and the structures show some vitrification where elements are melted and diffuse in each other, this may mean MHJ 3 was overfired mistakenly or fired at a higher temperature compared to other artefacts.

6.3.2 Harappa

The results of EDX analysis on Harappan potsherds revealed there are minor variabilities of elemental concentrations among the three artefacts. The result suggest that the raw material of the pots was collected from a similar location as shown in table 15 and compared in table 16.

Element	Symbol	Atomic number	HRP 1	HRP 2	HRP 3
Carbon	C	6	0	20.80	9.42
Sodium	Na	11	2.04	1.08	1.15
Silicon	Si	14	26.51	39.74	21.22
Aluminium	Al	13	17.52	16.85	10.03
Calcium	Ca	20	11.36	1.46	11.26
Sulfur	S	16	8.21	0	14.73
Chlorine	Cl	17	2.16	0	0
Iron	Fe	26	11.31	10.33	10.74
Magnesium	Mg	12	2.30	2.39	2.24
Pottasium	K	19	11.59	7.35	19.23
Titanium	T	22	0	0	0

TABLE 15. Elemental composition of Harappa artefacts

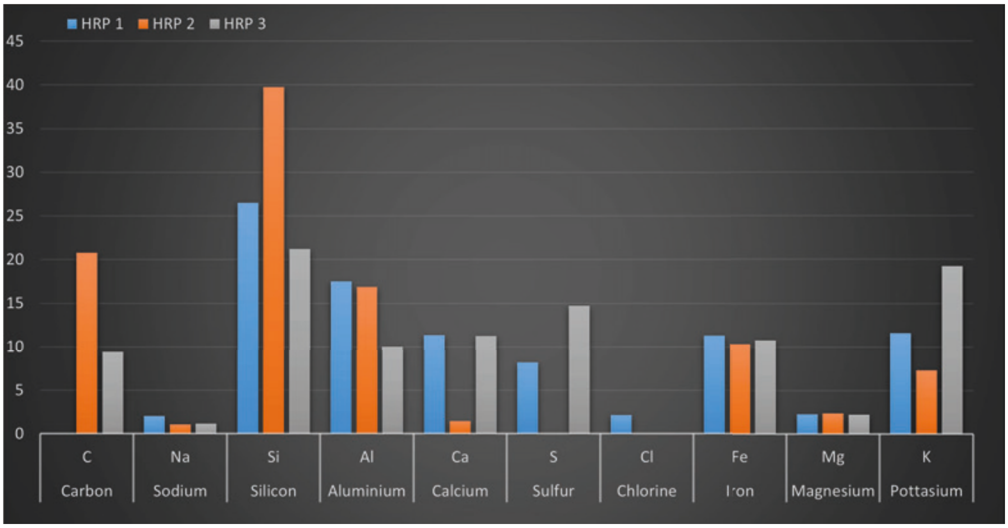


Table 16. Comparison of Harappa artefacts

Sodium, and Magnesium give almost equal values in the three artefacts. However, other minerals provide minor variabilities. The amount of calcium oxide in HRP 1 and HRP 3 is greater than 6 %; thus the artefacts have calcareous clay. Although the content of calcium oxide in HRP 2 is lower than 6%, that elaborated the non-calcareous nature of the clay.

The SEM photomicrograph shows that HRP 1, HRP 2, and HRP 3 have grains like structure and similar internal morphology . The iron and calcium composition is almost similar in HRP1 2 and 3 that suggests that all three pots were fired at a similar temperature lower than 800 °C. The results also suggest that the pots might belong to the same artisan as shown in figure 83.

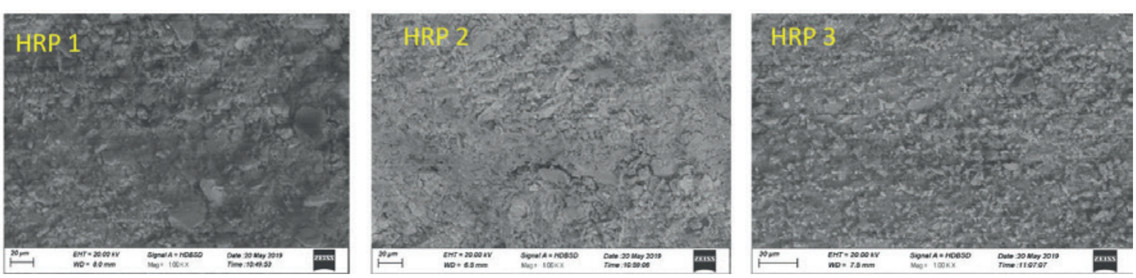


Figure 83. SEM micropictograph of Harappa artefacts

6.3.3 Ganweriwala

The EDX results of the artefacts from Ganweriwala settlement show that silicon is the second most dominant element in GNW-1 and GNW-3 while carbon is more dominant element in GNW-2. The high silica content is caused by the presence of quartz in the sample 1 and 3 while low silica content in sample 2 indicates the absence of quartz. Next to silica, the most dominant elements are Al, Ca, Fe, and Mg as shown in table 17 and compared in table 18.

Element	Symbol	Atomic number	GNW 1	GNW 2	GNW 3
Carbon	C	6	6.72	24.7	3.84
Sodium	Na	11	0.62	0.73	0.38
Silicon	Si	14	14.04	7.58	22.62
Aluminium	Al	13	7.34	3.05	3.14
Calcium	Ca	20	0.49	4.74	1.15
Sulfur	S	16	0	0.6	0
Chlorine	Cl	17	0	0	0
Iron	Fe	26	1.57	0.96	1.72
Magnesium	Mg	12	1.51	0.7	0.66
Pottasium	K	19	0.84	0.63	0.96
Titanium	T	22	0.14	0	0
Oxygen	O	8	66.72	56.31	65.52

Table 17. Elemental composition of Ganweriwala artefacts

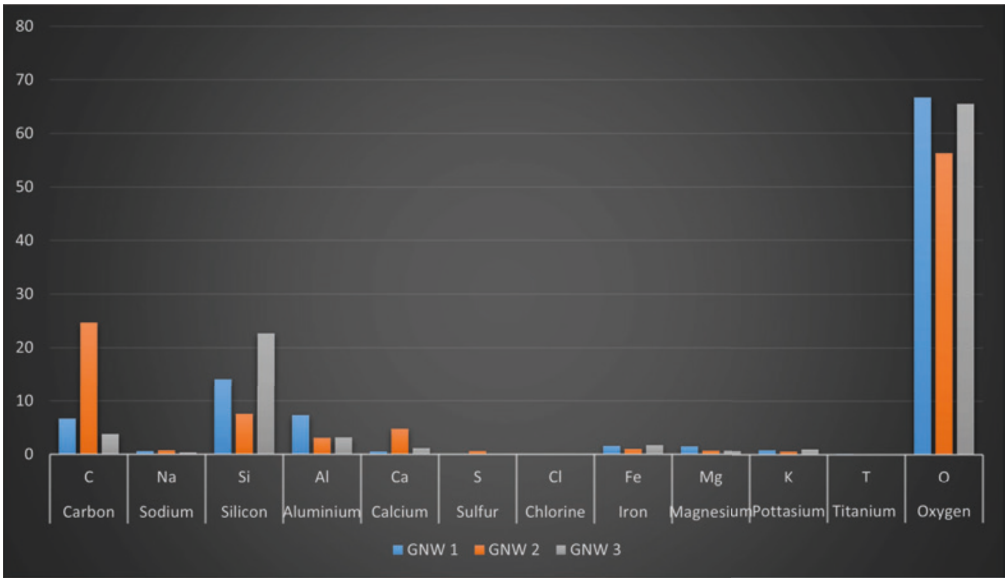


Table 18. Comparison of Ganweriwala artefacts

The content of Ca is less than 6% in each of the three samples indicating that the material is a non-calcareous type. The content of iron indicates the color of pottery samples. The red color of the pottery (e.g. sample GNW-1) is due to the presence of hematite and the black color (e.g. sample GNW-2) is due to higher amounts of magnetite (Mirti & Davit, 2004; Mirti, et al., 2006). Carbon is an organic element in clay composition that improves the physical properties of soil and increases the water holding capacity of sandy soil. It contributes to the structural stability of clay soil helping to bind particles into aggregates of which carbon is a major part and holds a great proportion of nutrients and trace elements that are very significant to plant growth (Leeper & Uren, 1993).

The EDX-SEM results of Ganweriwala demonstrate that the raw material of three potsherds is from a similar location. The clay minerals of these three pots have calcium oxide of less than 6%; thus the clay used for artefacts is non-calcareous. The composition of fluxes is lower than 9% which means the clay used to make the pot is a high refractory type (Maniatis and Tites, 1981).

The iron and calcium composition of GNW 1 and GNW 3 are almost similar, shown in table 13; however, GNW 2 has a different composition which means that GNW1 and GNW 3 were fired at similar temperatures, although GNW 2 is different, as shown in figure 84.

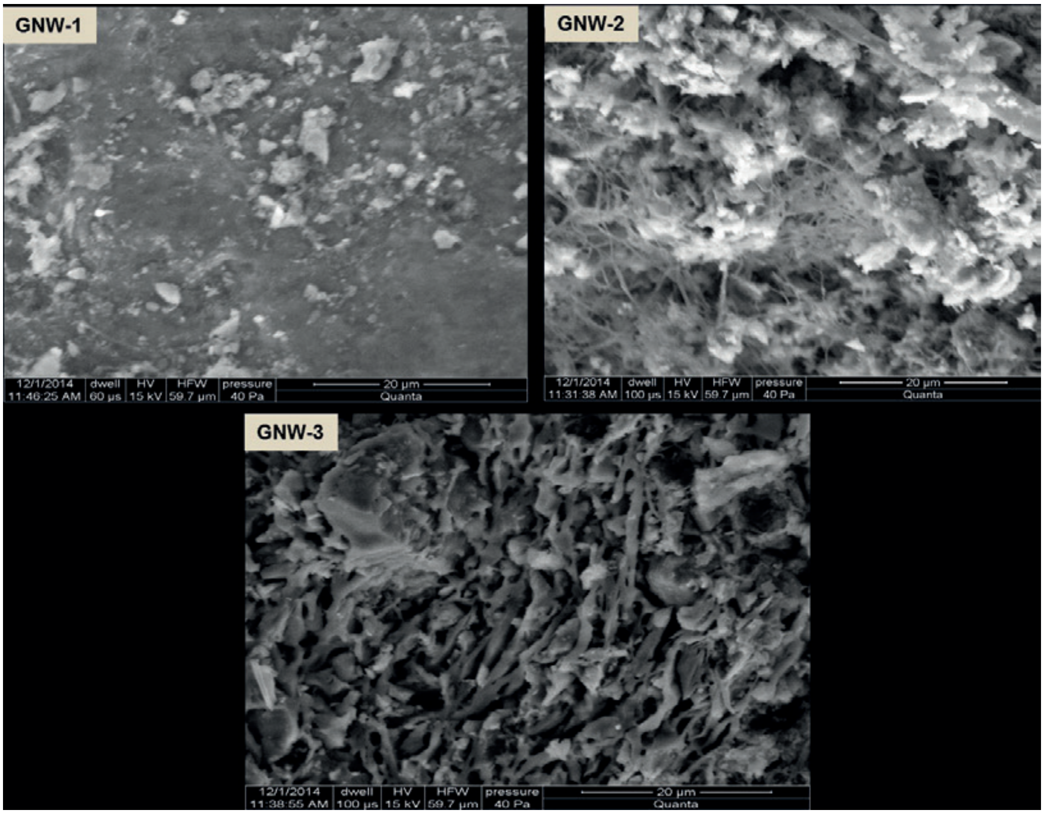


Figure 84. SEM pictographs of Ganweriwala artefacts

The photomicrograph GNW-1 in figure 84 shows that mineral particles are readily distinguished with very little grain-to-grain contact. This means that the pot does not have vitrification and the elemental analysis shows it is from the non-calcareous type of clay. According to Maniatis and Tite (1975), low refractory non-calcareous clays produced in oxidizing conditions with no vitrification stage were fired at less than 800 °C. Of the other samples, GNW-2 in figure 84 shows initial vitrification and GNW-3 in figure 84 shows extensive vitrification. The material contents seem to be melted and grains are well mixed as compared to GNW-1. The trace minerals need to be fired at a temperature higher than their melting points to form the smooth shape and contact between grains. Thus, the elemental analysis showed that these samples (GNW-2 and GNW-3) are also of a non-calcareous type. These types of samples were usually fired at 850-950 °C (Tite & Maniatis, 1975). Furthermore, in GNW-1 and GNW-3, silicon is the second most dominant element after oxygen, while in GNW-2 carbon constitutes the second highest mineral after oxygen. From this, I can conclude that the firing temperature of GNW-1 is lower than GNW-3 because it looks that GNW-3's temperature is close enough to start vitrification, as shown in figure 84.

This is also true from the nature of the sample GNW-1 as these types of artefacts are not fired with very high temperature. The image for sample GNW-2 shows some rod shaped material which might be the presence of carbon because carbon does not melt in lower temperatures; rather it sublimates at a very high temperature at about 3600 °C. It is obvious that it is not possible to reach this temperature in open space for making pottery. I thus believe that the firing temperature for GNW-2 is higher than GNW-1, but may be equal to that of GNW-3 (850-950 °C) as discussed in 6.2.

6.4 Comparison of the Group 1 (cooking and processing) artefacts from Mohenjo Daro, Harappa and Ganweriwala

The three artefacts from Mohenjo Daro, Harappa and Ganweriwala named as MJH 1, HRP 2 and GNW 1 have been compared to analyze elemental variability and firing temperatures shown in figure 85.

FIGURE 85. Potsherd from Mohenjo Daro, Harappa and Ganweriwala

The EDX-XRF results of these artefacts shows the variability in elemental composition shown in table 19 and compared in table 20.

Element	Symbol	Atomic number	MHJ 1	HRP 2	GNW 1
Carbon	C	6	36.65	20.80	6.72
Sodium	Na	11	10.30	1.08	0.62
Silicon	Si	14	13.22	39.74	14.04
Aluminium	Al	13	6.90	16.85	7.34
Calcium	Ca	20	9.63	1.46	0.49
Sulfur	S	16	6.48	0	0
Chlorine	Cl	17	4.43	0	0
Iron	Fe	26	6.42	10.33	1.57
Magnesium	Mg	12	2.14	2.39	1.51
Pottasium	K	19	3.83	7.35	0.84
Titanium	T	22	0	0	0.14
Oxygen	O	8			66.72

TABLE 19. Elemental composition of different artefacts

Pot Sherd code	Clay type	Vitrification stage	Firing temprature C
MHJ 1	C	NV	750
HRP 2	NC	NV	750
GNW 1	NC	NV	750

C= Calcaroues soil

NC= Non Calcaroues soil

NV= No vitrification

Table 20. Comparison of elemental composition of Mohenjo Daro Harappa and Ganweriwala potsherds

MHJ 1, HRP 2, and GNW 1 have different elemental compositions but were baked at 750 °C. Although the clay paste of artefacts shows different mineral compositions that suggest the artefacts were locally produced, they show similar production technology.

The similar production techniques of the pottery suggests all settlements had plenty of fuel for reaching the climax of firing temperatures, particularly Ganweriwala settlement. GNW 1 in figure 84 shows important results about production techniques and reflects upon the availability of sufficient fuel resources.

Comparison of Perforated Jars

Three Samples of similar types of vessels known as perforated jars have been selected to analyze variabilities. Artefacts are shown in figure 86.

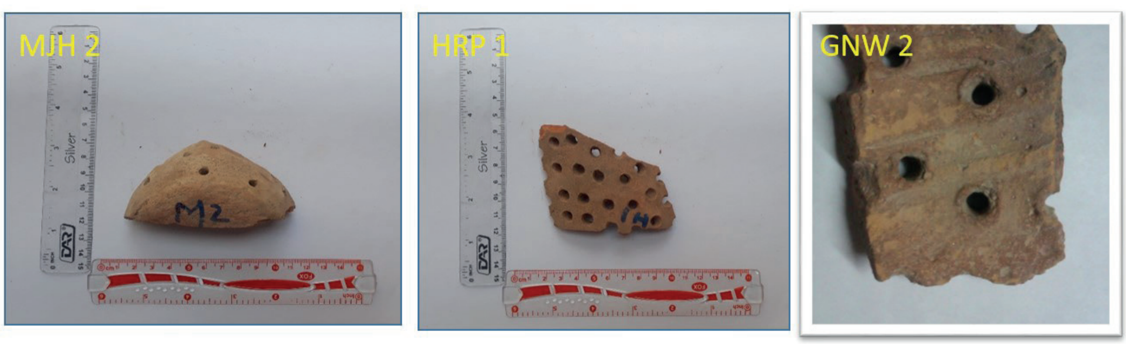


Figure 86. MJH2 from Mohenjo Daro settlement, HRP 1 from Harappa settlement and GNW 2 from Ganweriwala settlement

Results are discussed below and compared in table 21.

Element	Symbol	Atomic number	MHJ 2	HRP 1	GNW 2
Carbon	C	6	0	0	24.7
Sodium	Na	11	2.27	2.04	0.73
Silicon	Si	14	36.03	26.51	7.58
Aluminium	Al	13	16.18	17.52	3.05
Calcium	Ca	20	20.50	11.36	4.74
Sulfur	S	16	0	8.21	0.6
Chlorine	Cl	17	0	2.16	0
Iron	Fe	26	12.97	11.31	0.96

Element	Symbol	Atomic number	MHJ 2	HRP 1	GNW 2
Magnesium	Mg	12	4.14	2.30	0.7
Pottasium	K	19	6.69	11.59	0.63
Titanium	T	22	1.21	0	0
Oxygen	O	8			56.31

Table 21. Comparison of elemental composition of perforated jar from Mohenjo Daro, Harappa and Ganweriwala

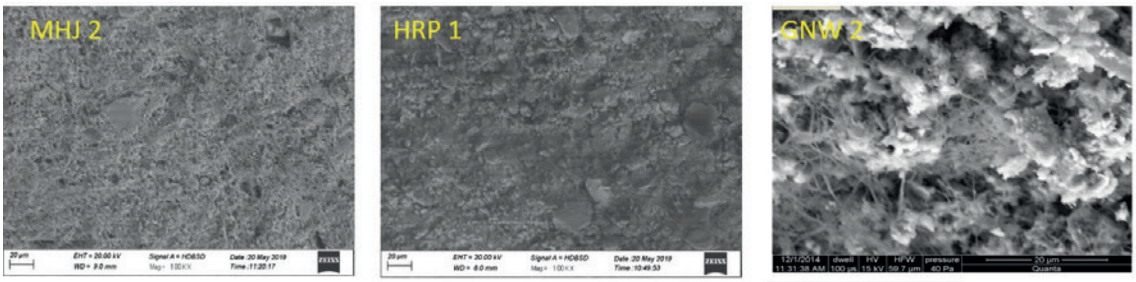


Figure 87. SEM pictographs of perforated jars

The results of SEM-EDX of perforated jars from Mohenjo-Daro, Harappa, and Ganweriwala exhibit that MHJ 2 and HRP 1 both have calcareous clay, but GNW 2 has non-calcareous clay. The production technique of these jars is also similar to production techniques with a maximum firing temperature of 750 ^{o}C. Table 22 represents the details of firing temperatures

Pot Sherd code	Clay type	Vitrification stage	Firing temprature C
MHJ 2	C	IV	750
HRP 1	C	IV	750
GNW 2	NC	IV	750

C= Calcaroues soil

NC= Non Calcaroues soil

IV= Initial vitrification

Table 22. Firing temperature of perforated pots

6.5 Similarities and differences of artefacts production techniques

The results of the SEM EDX analysis show that the potter's Industry at Ganweriwala settlement adopted the similar production techniques as practiced at the Mohenjo Daro and Harappa settlements. All artefacts present different mineralogical compositions that mean the raw clay was locally procured at three different regions.

The comparison of cooking and processing artefacts shows the Indus urban period standardization of pottery production techniques at major urban centers. The results demonstrate that Ganweriwala potters had enough fuel to reach desirable temperatures around 750 degrees for the baking of pots. The pottery baking techniques suggested that the regional environment of Cholistan was favorable for specialized pottery production and they might have had sufficient amounts of raw clay, water, and fuel.

There is also possibility that the potters have some centralized schools to learn the pottery-making art and were then hired by regional administration. The results of the above mentioned analysis suggest that a higher degree of standardization in production techniques even at larger distances was a common practice during the urban period. However, present analysis is providing tentative results and more artefacts need to be analysed for concrete results.

CHAPTER 7

Comparative analysis of urban attributes from the major Indus settlements

The results of qualitative analysis of Mohenjo Daro, Harappa, Dholavira, Ganweriwala, and Rakhigarhi settlements discussed discussed in chapter 5 shows that the type and scale of these five settlements are variable. Although a number of important similarities exist in general terms, the architectural remains and topography exhibit substantial variabilities that mark the distinctive nature of the settlements. Based on archaeological evidence, these five settlements were analysed using an attribute-based analysis, as discussed in Chapter 2. The layout, built environment, population density and size, burials, writing, subsistence, and socio-economic special productions from each settlement are critically analysed and compared in this chapter. The results show that the five larger settlements of the Indus society have variable scales.

7.1 Comparison of Urban attributes

7.1.1 Landscape and locations

The five known major urban centers of the Indus society are located at very large distances that marked different ecological zones and different landscapes such as Mohenjo Daro, Harappa, Ganweriwala, and Rakhigarhi (Wright, 2010). But the environment of these four settlements differ substantially as already discussed in Chapter 5. The intensity of rainfall and the types of water sources varies in between the ecological zones of these 4 settlements discussed in chapter 5. Thus, these five urban centers were probably regional administrative units that functioned at different scales for the socio-cultural, economic, and urban development of the Indus society. The geographical locations of these large urban centers suggest that they were developed on an equidistant pattern to maintain communication and regional control of resources. The approximate distances among these urban centers are as follows:

Harappa to Mohenjo Daro 681 km

Rakhigarhi to Harappa 336 km

Harappa to Ganweriwala 290 km

Ganweriwala to Mohenjo Daro 314 km

Mohenjo Daro to Dholavira 268 km

Dholavira is located approximately 268 km from the Mohenjo Daro settlement and is about 103 km from the Gulf of Kutch. The distance from Dholavira to the sea is the minimum compared to the other settlements; however, from Mohenjo Daro, the travelling is much easier because of the Indus River. Downstream travel is easier by boat than upstream.

Ganweriwala settlement is situated approximately 6 to 8 km away from the dry bed of the Hakra. Rakhigarhi is located approximately 27 km away from the Ghaggar River. Mughal suggested that it might have been a control center of copper resources given its proximity to Rajasthan, India (Mughal, 1997). Dholavira was a port city that might be a vital city for trade and exchange (Possehl, 2002; Guar, et al., 2019).

The largest urban center, Mohenjo Daro is situated only 1.5 km away from the bank of the river Indus, as shown in figure 88.

FIGURE 88. Distance between Mohenjo Daro to Indus River: Approximately 1.5 km

The River Indus flows towards the Arabian Sea in the south. The location of Mohenjo Daro has a strategic position and its active role in foreign trade and exchange. Mohenjo Daro is the only largest settlement that is located on the bank of a major River. It has direct access to the Arabian Sea through the River Indus. Direct access to the sea makes it easier to maintain trade contacts with the neighbouring regions such as Bahrain, Oman, and Mesopotamia. The strategic location of Mohenjo Daro is very important as compared to other large settlements.

The second largest settlement Harappa is located approximately 681 km northeast from Mohenjo Daro on the bank of the River Ravi. Present-day Ravi River is almost 11 km away from the Harappa settlement as shown in the figure 89.

However, the excavation remains suggest that the river was much closer during the urban period around 2600 BCE, but because of river avulsion, it changed its route.

Ganweriwala and Rakhigrahi are both situated on the bank of the old channel of the river Ghaggar-Hakra system. The geographical locations of these urban centers stressed their importance as major socio-economic organisations that developed in a sea of small settlements, as discussed in Chapter 4. But these settlements do not have direct access to the Arabian Sea. The difference between the strategic position of Mohenjo Daro, Harappa, Ganweriwala, and Rakhigarhi suggested that the approachable routes for individual settlements to reach the sea were different. Mohenjo Daro and Harappa were connected through the River Ravi and River Indus. Ganweriwala and Rakhigarhi were connected by the Ghaggar Hakra River system. The settlements of Harappa and Mohenjo Daro were connected to

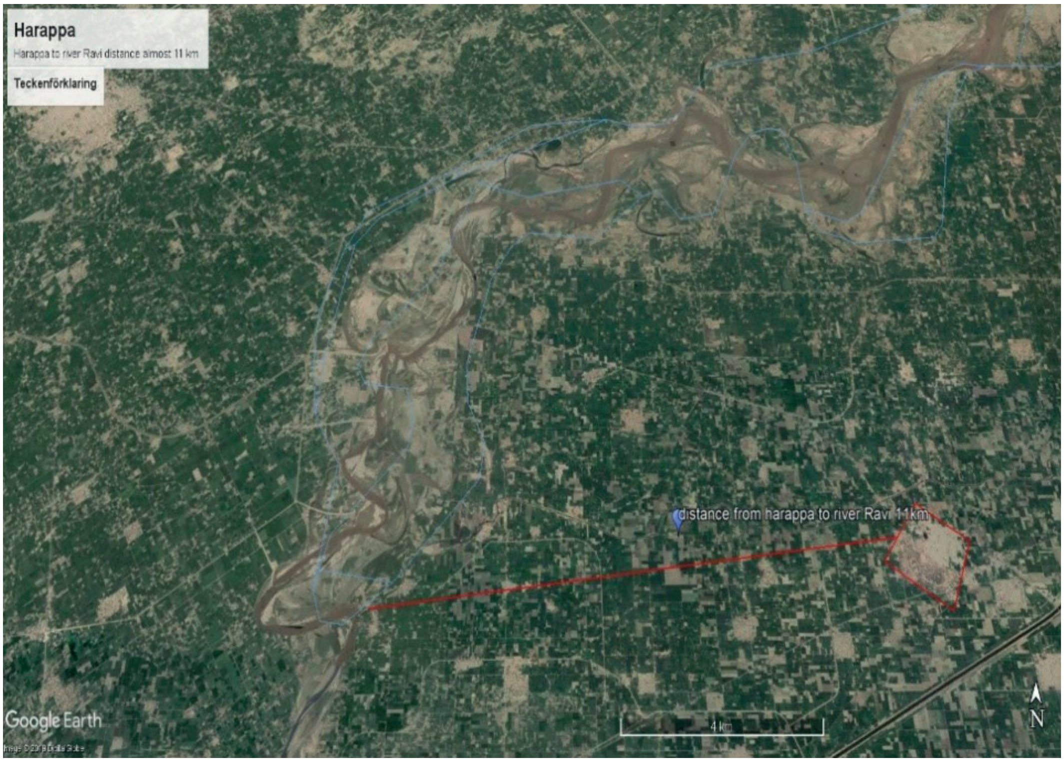


FIGURE 89. Present-day distance between the Harappa settlement and Ravi River is approximately 11 km

the Sea through the river Indus. Ganweriwala and Rakhigarhi might be connected through the river Ghaggar Hakra. Dholavira has a different route and has direct access to the sea.

The Dholavira settlement is located at the Kutch Island in Gujarat, which has a very different environment compared to the other four large settlements mentioned above. There are no major rivers around the Dholavira settlement; instead, the region has some small seasonal streams. The archaeological evidence suggests that people were dependant on rain water and seasonal streams, and for this reason, they built water reservoirs to save water. This type of water harvest system is unknown from any other large settlement. It makes clear that the people were well aware of a range of different water management techniques in a challenging environment. However, the settlements that had plenty of flood water were lacking a canal system.

The spatial locations of the settlements suggest that the distribution of regional centers were planned in terms of a utilitarian perspective. The equidistant pattern provides a practical solution to maintaining communication and controlling regional resources. For example, if a farmer had to travel from Rakhigarhi to Harappa to exchange products, he/she might look at four sunrises to calculate his journey towards Harappa. This also gives us a clue that Harappa might be the control center of resources from the northern regions, given that the evidence of lapis lazuli and several other precious stones emphasises its trade links with northwestern regions (Law, 2008). In the case of Mohenjo Daro, because of its direct access to the Arabian Sea, it might have been the major urban center to control trade within the central and western Asian communities.

7.1.2 Settlement size and density

An interesting feature of the Indus urban centers are inconsistent sizes. Most of the settlements are not completely excavated and this hinders the understanding of settlement size. One of the major reasons is that the Indus urban centers are larger than indicated by the mounds visible on the surface before excavations. However, several factors have a negative effect on the measurement accuracy of settlement sizes, such as the incomplete and scattered nature of Indus settlement ruins, modern changes over landscape, human vandalism, and higher water table problems, as discussed in Chapter 3.

Comparison of Indus settlement sizes is thus difficult using available data. To tackle the problem of unreliable settlement sizes, I have analysed two different scales of measurements, coding with the minimum and maximum size limit. First or minimum size scale is a general size description based on the early investigations. Later or maximum size scale is based on more recent investigations or after excavations. Minimum size scale corresponds to the size of visible mounds on the ground but maximum size scale presents the limits of the ruined structures or the total size of the settled area. The average of both categories of sizes are analysed below.

The earlier investigations of these urban centers suggested that the Mohenjo Daro settlement has an area of 83 ha (Mackay, 1938), the Harappa settlement has an area of 76 ha (Fentress, 1976), Ganweriwala has an area of 81.5 ha (Mughal, 1997), Dholavira is an area of 47 ha, and Rakhigarhi has an area of 60 ha (Possehl, 2002). Comparison of these sizes is discussed below in figure 90.

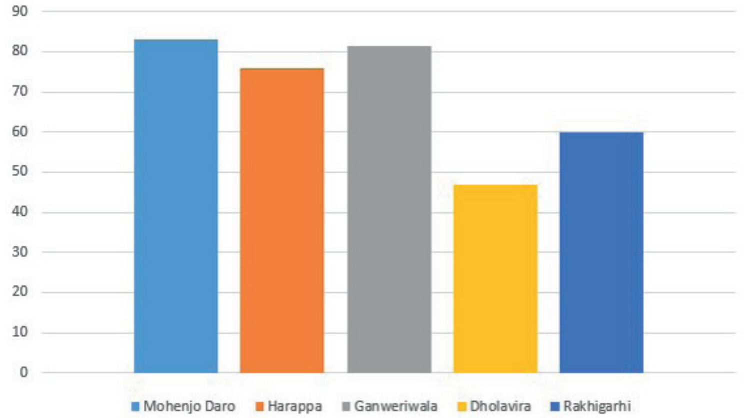


Figure 90. Variations among the Initial reported settlements sizes

The earlier estimation of the settlement sizes was revised and has conflicted several times, but the latest estimation is that Mohenjo Daro is an area of between 125 to 200 ha, Harappa is 150 ha, and Ganweriwala is approximately 67 ha (preliminary estimation of mounds although the settled area can provide different results). However, the size of the Rakhigarhi settlement is still uncertain, and there is limited published work. Generally, it is considered to be a settlement between 60 to 80 ha in size. Dholavira has an estimated size of between 47 to 100 ha (Wright, 2010). My estimation of the sizes are shown in figure 91.

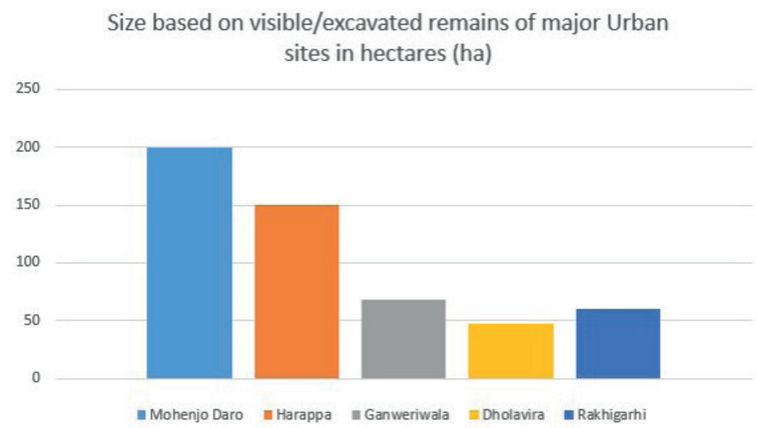


FIGURE 91. Variation among revised settlement sizes. Because Ganweriwala is not excavated yet and Rakhigarhi is the least investigated, the size of these two settlements does not show any remarkable difference in the chart.

The difficulty among the size variation of excavated and unexcavated settlements is a major problem for understanding the settlement scale. Therefore the estimated results of the present study regarding size scale can be changed in light of future research. But the earlier evaluations of settlement sizes, shown in Figure 90, indicate that Mohenjo Daro, Harappa, and Ganweriwala have an equivalent settlement size scale.

Settlement size is often correlated with demography, which is an advanced indicator of settlement development and process. Population size is also an effective indicator of organisational complexity (Carneiro, 1967). The population of the Indus settlements can be can be derived by the area estimation method. This method works with a flat density coefficient of the area and then multiplies it with the total area of the site. The coefficient, when addressing the macro region in question, is generally derived by analogy with pre-modern Muslim settlements, with the consideration that habitation patterns did not change much until the 20th century (Broshi & Gophna, 1984; Adams, 1981). This method allows for a quick comparison of various regional settlements. Based on present-day settlement analogies, the ancient Indus society's habitation has been calculated to be 150 to 200 people per hectare (Possehl, 1998; Wright, 2010).Thus, the estimated population lived in these urban centers can be estimated as shown in figure 92.

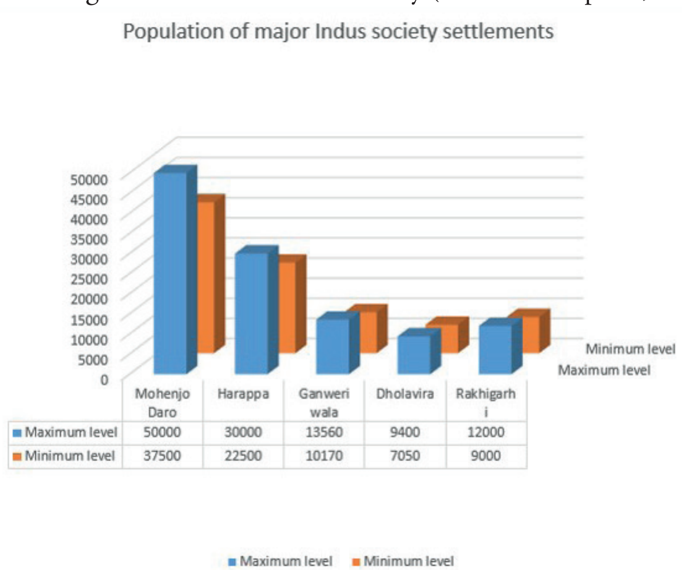


FIGURE 92. Population density of different cities

Based on the classical discussion of settlement sizes, early reported sizes, estimated sizes, and density, it is clear that Mohenjo Daro settlement has the highest scale compared to all other settlements.

However, current variation among settlement sizes suggest that

Ganweriwala settlement has a size scale closer to the Moehnjo Daro and Harappa settlements. The settlement has not been excavated, and available data does not give information on it. Thus, architectural density is not known. For this reason, Ganweriwala settlement cannot be placed on an equal scale to Mohenjo Daro until confirmed by excavation. But, the architectural density and settlement size of the Harappa settlement is less dense compared to Mohenjo Daro, as discussed in the next section. Thus, I estimate that the size scale of Ganweriwala settlement is much closer to the Harappa settlement. However, the settlement density is much closer to the Rakhigarhi and Dholavira settlements.

The Mohenjo Daro settlement has a greater scale in terms of size and density as compared to all other settlements. Ganweriwala, and Rakhigarhi have closely similar size and density. Harappa has greater density and size than Ganweriwala and Rakhigarhi but lesser than Mohenjo Daro. Dholavira has a smaller size and lower density as compared to the other 4 larger settlements. It must be stressed that the results suggest that the Mohenjo Daro settlement has a distinct urban nature as compared to other settlements.

7.1.3 Built environment

In Chapter 5, I described a set of features for the urban centers under discussion. According to this study, the Mohenjo Daro settlement is the most complex. The density of architectural structures per hectare at Mohenjo Daro is higher than at any other large urban center. The settlement has three different elevations, which make a distinction among different districts of the urban center. The settlement was planned with an elaborate transportation infrastructure, followed by a major street that intersects several smaller streets and passageways. Almost every house had the opportunity to access fresh water for drinking, toilets, and a drainage facility. Mohenjo Daro also has a distinct structure known as the great bath, which is missing at other urban centers. The Harappa settlement has the remains of covered drains, wells, granaries, and workshops, but its architectural features do not seem equivalent to the Mohenjo Daro settlement. Most parts of the Harappa settlement were not preserved, and almost half of the settlement is occupied by a modern village. The Dholavira settlement also presents three different elevations of settlement planning and has water reservoir features, as discussed in Chapter 5.

There are no available studies on architecture and structure as far as Ganweriwala and Rakhigarhi sites are concerned. Ganweriwala and Rakhigarhi are exempt from architectural and structural studies. Future studies are required for both settlements. However, different attributes from the archaeological remains are discussed below.

7.1.4 Architecture and town planning

The five large urban centers have different urban developments and processes. The Mohenjo Daro and Dholavira settlements were developed around 2700 BCE, which suggests they were deliberately planned; however, they present different settlement plans. The Harappa, Rakhigarhi, and Ganweriwala settlements had longer periods of urban development which started before 2700 BCE, as discussed in Chapter 5.

The analysis of the citadels or Upper towns of Mohenjo Daro, Harappa, and Dholavira settlements discussed in Chapter 5 demonstrate different types of planning at three settlements, as shown in the figure 93.

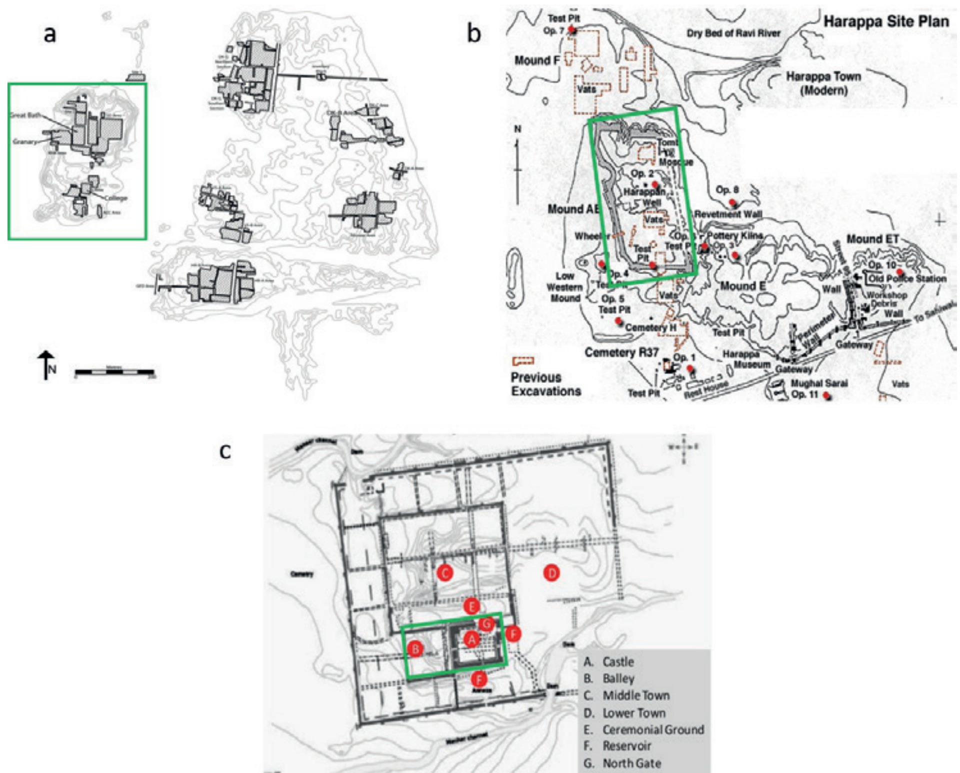


Figure 93. Part a presents Mohenjo Daro's Upper Town, b presents Harappa´s Upper town, and c presents Dholavira´s Upper town. The structures clearly demonstrates the differences in planning and divisions of space in these three towns.

The archaeological remains of the settlements do not show any major structural similarities. Mohenjo Daro's Upper town (figure 93, Part a) consists of three distinct types of structures known as the great bath, pillared hall, and the granary, already discussed in Chapter 5. The structures of the citadel or Upper Town of the settlement were constructed on a mud-brick platform known as fortification; however, Possehl criticised this type of fortification when used for defensive purposes. He suggested that mud-brick platforms can protect the settlement from flooding but are not an effective measure against defensive purposes. In contrast, the Upper town of the Dholavira settlement (Figure 93, Part c) consists of the palace, two small stone lined water tanks associated with a well and bailey that are already discussed in chapter 5. The structures of the Upper town were fortified using massive walls. The Upper town of the Harappa settlement (figure 93, Part c) does not show any significant architectural structures, as there is only a fortification wall visible today. The structural units of the Upper town from the Mohenjo Daro, Harappa, and Dholavira settlements have variability, as shown in the table 23.

	Mohenjo Daro	**Harappa**	**Dholavira**
Citadel structures	Great bath, pillared hall, granary	Fortified rectangular part but structures are not clear	Palace, bailey, 2 Water tanks and 1 Well

Table 23. Comparison of the Upper towns of the three excavated settlements

The structures belonging to the Upper town of the Mohenjo Daro settlement, such as the great bath, granary, and pillared hall, are different from the Upper town structures of any other settlement. The Dholavira settlement, for example, has a palace and bailey which are architecturally different. The Upper towns of Mohenjo Daro and Dholavira have different types of structures, but both settlements have a similar type of general layout. That structure at Mohenjo Daro is known as the pillared or assembly hall. At the Dholavira settlement, there is a similar type of structure located between the Upper town and the middle town. This structure is known as the ceremonial ground or assembly hall. The pillared hall of the Mohenjo Daro settlement is located to the south of the great bath, as shown in figure 94. It is a square structure consisting of 20 rectangular pillars and covered by a roof. At the Dholavira settlement, the rectangular hall is located to the north of the palace. Both structures are located in the proximity of monumental structures, like the great bath and the palace, which emphasises their importance. These structures were used for administrative meetings or could have been used for ceremonies. This type of structure is missing at the Harappa settlement (It can be because of destruction for railway construction).

FIGURE 94. Part a shows the pillared or assembly hall at Mohenjo Daro, and b shows the ceremonial ground or hall at Dholavira

Another difference between these settlements is the construction material. Dholavira was constructed with finished stones, but all other settlements used baked bricks. The Dholavira settlement was planned as a square alignment, but the Mohenjo Daro settlement is oblong in a north-south alignment, and the Harappa is irregular in shape. Architectural structures are very elaborate and more complex at Mohenjo Daro, like the great bath, houses, wells, and lanes as discussed in 5.1.4.

Harappa presents poor data for an architectural study. The Upper town does not contain any significant structures. Harappa's main architecture are the defensive wall, granaries, and workman's quarter that consists of 14 houses, but not a single example contains complete evidence, circular platforms, or a cemetery. The citadel area of the Mohenjo Daro settlement and Harappa settlement are almost equal in size at 8 ha and 10 ha, respectively.

The citadel area of Harappa is slightly different from the Mohenjo Daro settlement. The citadel area of Dholavira is 280 x 140 m^2. It is smaller in size compared to the Harappa and Mohenjo Daro settlements.

Another comparative element is the Upper town's elevation from ground level. The Mohenjo Daro and Harappa's citadels are raised 45 m from ground surface, although Dholavira's elevation is different from south to west, 15 x 18 m, respectively. For comparison, I have taken the highest point from ground level, which is 18 m.

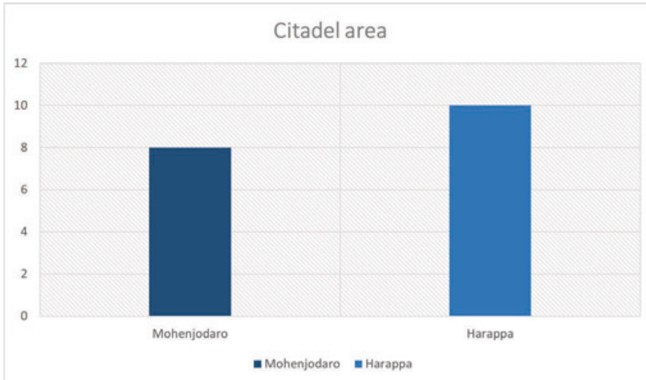


Table 24. Mohenjo Daro citadel area is 8 ha, and the Harappa citadel area is 10 ha

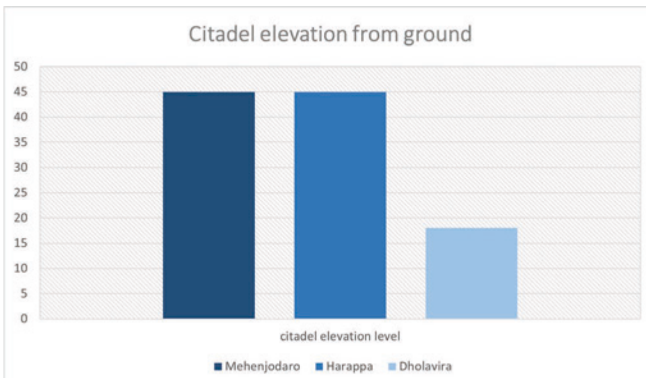


Table 25. Mohenjo Daro, Harappa, and Dholavira citadel elevations from ground level

The fortification walls of these settlements are also different. There is a slight difference between the citadel fortification walls of the Dholavira and Harappa settlements, and it is probably because of different material composition. Dholavira's wall is 11.6 m in terms of width, and Harappa's wall is 15 m, as shown in table 26.

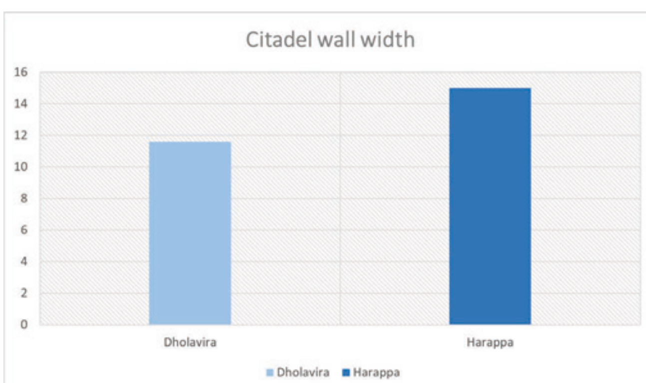


Table 26. Citadel wall width of Harappa and Dholavira

In the case of Mohenjo Daro settlement, Wheeler has reported a three meters high baked-brick buttress on the western margin, but Jansen found no wall against the granary (Jansen, 1987) and explains there is a mud-brick retaining wall around the citadel. Mohenjo Daro settlement has a different type of fortification as discussed in chapter 5.

7.1.5 Special or monumental architecture

The monumental architecture of the Indus society is not comparable to Mesopotamian ziggurats or the Dynastic pyramids of Egypt; however, urban centers have some distinctive structures that can be understood in terms of special architecture instead of monumental architecture. For example, Mohenjo Daro has the great bath that might have had a special function. This structure is unknown in any other Indus urban center. Harappa has large granaries and workman's quarters with circular platforms located in the Upper town. The function of the granaries is not clear yet, but they might be a storage place for grains used by the administration. Rakhigarhi's rectilinear structures might serve as granaries, but it is not clear yet. However, the cemetery from the Rakhigarhi settlement is an elaborate structure. Dholavira is unique because of its water reservoirs, which are not common in any other urban centers. All urban centers have some special and distinctive structures, as shown in the figure 95.

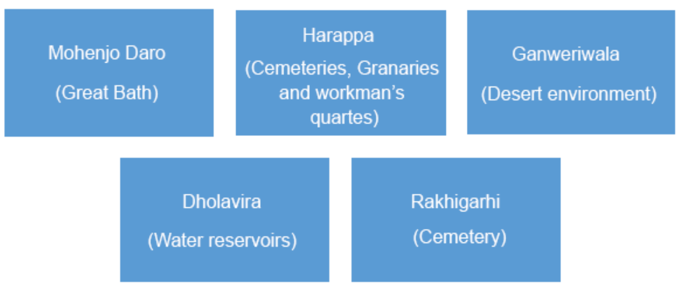


Figure 95. Distinct structures of five major urban centers

These special structures are compared below.

The great bath of Mohenjo Daro and water reservoirs of Dholavira are associated with water as a dominant feature of socio-cultural practices. The reservoir of Dholavira was used to collect water from rain and seasonal streams, and might have been used during the dry season. The great bath of Mohenjo Daro was used for ritual performance and might have been used only by a limited group of people. Dholavira has 19 or more water reservoirs with different shapes, sizes, and depths, but Mohenjo Daro has only one bath. Dholavirian reservoirs cover an area of 10 ha of the site, which corresponds to 20% of the total area of the settlement. During the rainy season, all reservoirs received water and were designed to protect the water from evaporation and ground seepage. The collected water might have been used for irrigation. I discuss two water reservoirs of Dholavira for my analysis: one located in the east at a 22 m distance from the castle structure, and the other located to the south of the castle near the annex.

The eastern reservoir is rectangular in shape, and only one-third of this reservoir has been excavated. The four walls of the reservoir bear an outward slope from the bottom upwards. The length of the eastern reservoir at the top extent is 73 m and approximately 70 m at bottom, with a depth of 7.5 m. The architectural features of the eastern reservoirs are a flight of 31 steps and a rock-cut well within a walled enclosure. In the east to the western city wall, there is a series of cultivated fields bounded by an eastern reservoir. Across the fields there are some faintly visible remains of cross walls similar to a bund structure. The other reservoir is located to the south of the castle near the annex. It is 95 m long, 10 m wide, and 4 m deep.

Mohenjo Daro´s great bath is 7 m wide and 2.4 m deep with a rectangular shape that is different from the reservoir's structure in the Dholavira settlement. The southern reservoir of the Dholavira settlement is 10 m wide and 4 m deep, which is slightly different from the depth and width of the great bath in Mohenjo Daro. However, the length of Dholavira's water reservoir is 95 m and Mohenjo Daro is 12 m, so that is about 8-times larger than the great bath of the Mohenjo Daro settlement, as discussed in figure 96.

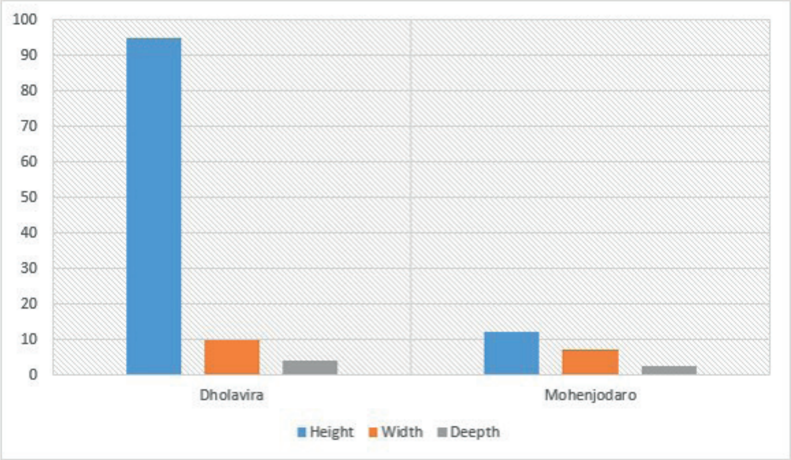


FIGURE 96. Structural differences of Dholavira's southern water reservoir and Mohenjo Daro's Great Bath

The great bath of the Mohenjo Daro settlement is surrounded by a densely built environment followed by a veranda or a roofed platform and several small enclosures. The architectural details and structural features makes it a distinct structure compared to the water reservoir at the Dholavira settlement.

Another significant structure at the Upper town of Dholavira is the complex of a well and two water tanks. The complex of the well and water tanks is situated to the south west corner of the castle. This complex consists of a well, two associated water tanks, and some drains. The well is 13.60 m deep and has 4.25 m internal diameter in the north-south direction and 4 m along the east-west direction. It is suggested that the well was constructed during the stage IV and had been used all through and up to Stage VI.

Almost 9 m to the north of the well, there is a larger water tank known as water tank 1 and 13.20 m to the north east there is a smaller water tank known as water tank 2. Both water tanks are connected to the well through a complex system of drains and lie parallel to each other with 4.70 m distance apart.

Tank 1 internally measures 4.65 m north-south and is 70 cm wide. In the center of the tank, there is built a miniature tank having the length, width and depth of 80 cm each. On the floor, there are deep use marks which can be caused only when one descends in the tank and makes use of the floor for grinding, polishing, or pounding something. Tank 2 is 4.85 m deep and has a 2.20 m diameter to the north south and 2.30 m to the east west. Tank 1 is larger and tank 2 is smaller. Tank 1 seems to have been used for the collection of well water and tank 2 seems to have been used for bathing. This type of complex structure is very unique and not found at any other larger urban centers. As compared with the great bath at Mohenjo Daro, it is very different architecturally but it confirms that water has significant meanings in the socio-cultural life of the ancient Indus society. The great bath of the Mohenjo Daro and the well complex of the Dholavira are different architecturally but might have had similar functions in terms of ritual purification or for the personal use of higher status peoples.

7.1.6 Burials and deposited human bones

Most of the Indus society urban centers lack any large cemetery, such as Mohenjo Daro, which does not have evidence of burials. There is only evidence of around 42 scattered human remains at HR and VS area of Mohenjo Daro (Possehl, 2002). Only the Harappa settlement has three types of burial areas: one known as cemetery R-37 and cemetery H although there are some human bone remains at cemetery G. Cemetery R-37 belongs to the urban period; however, cemetery H belongs to the post-urban period.

At Dholavira, only one burial has been discovered. The skeleton was extended in a supine position with a copper mirror. Some stupa-like mud-brick architecture has also been discovered and is known as funerary, but there is no evidence of human skeletons (Dibyopama, et al., 2015).

At Rakhigarhi, there is evidence of an urban period cemetery which consists of 53 skeletons; however, more research is needed for accurate numbers (Shinde, 2018). The burial practices from the Rakhigarhi settlement are similar to the Harappa burial practices already discussed in Chapter 5.

Harappa

The largest cemetery of the urban period is the Indus society R-37 which contains 90 burials with a supine position (Possehl, 1998). All burials had a north-south alignment. The most significant burial goods are ceramics, shell bangles, copper rings, steatite disc, beads, Carnelian beads, and lapis and jasper micro-beads, all of which were mainly along with female skeletons (details already discussed in Chapter 5).

Mohenjo Daro

The largest city of Indus society has no evidence of a cemetery. However, 42 scattered skeletons have been discovered from the HR, VS, and DK areas. The skeletons do not show a built environment of burials, but they have been interpreted as the result of a massacre scenes. However, the evidence of massacre is poorly proven by the scientific study of the skeletons (Kennedy, 1984).

No evidence of burials within the settlement indicates that there might have been separate space for burials outside the settlement.

Ganweriwala

Until now, no burials or deposited bones have been discovered in Ganweriwala.

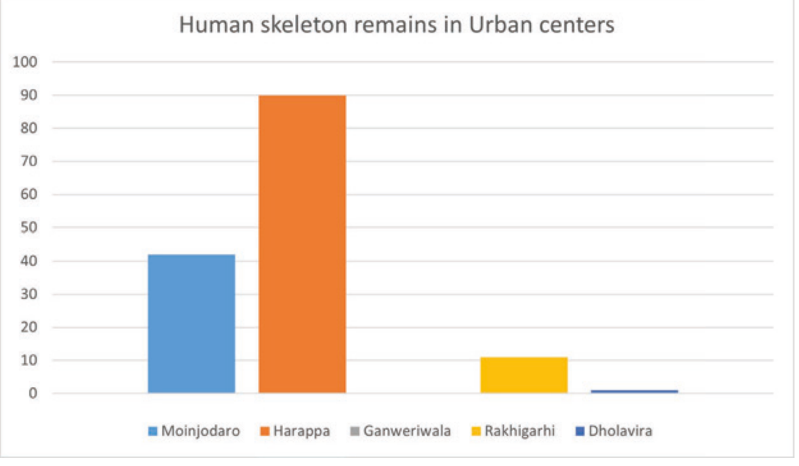


Table 27. Human skeletal remains at five Indus cities

In terms of a burial analysis, only Harappa and Rakhigarhi present good empirical data to compare. Both share similar burial practices, such as they buried with a north-south alienation. Ceramics, beads, and household items were the most common burial goods.

7.2 Comparison of Socio-economic practices and subsistence

As to date, there is no evidence of cultivation inside the built areas of the Indus urban center. They had separate cultivation lands probably in the surroundings of the urban centers. During the urban period, people adopted double cropping, depending on winter/spring and summer/fall weather systems (Petrie, 2017). Most of the regions were dependant on river water for irrigation. However, there is no evidence of any canal system, only the Dholavira settlement has a canal system. Cattle, goat, and sheep were used for domestication (Meadow, 1986). The subject of subsistence study is not well performed on Indus settlements, and there is limited information available. Only the Harappa settlement and Rojdi (a site in Gujarat) are well documented as concerns archaeobotanical studies (Weber, 2003; Bates , 2019).

The study at the Harappa settlement suggests that cereals like barley, wheat, and millet; Legumes like peas, pulses, gram; and oilseeds like mustard, sesame, and cotton linseed were cultivated during the pre-urban period (Weber, 1999). But during the urban period, wheat and barley were the most popular crops with little or no evidence of millet, fruit, or oilseed. The region around the Harappa settlement in the province of Punjab practiced double cropping for both summer and winter seasons (Petrie & Bates, 2017). The studies from the Mohenjo Daro settlement suggest that single-season cropping depending on the winter season was the most common practise. The region of Mohenjo Daro seems to be the subject of violent flooding during summer times, and for this reason it was impossible to practise double cropping (Miller, 2006).

There is no evidence of archaeobotanical studies at Dholavira, Ganweriwala, or Rakhigarhi, but another study of several smaller sites in the Gujarat region suggests single-season summer cropping practices (Weber, 1989).

The subsistence practices show that the regional environment had a great impact on the subsistence practices. Mohenjo Daro and Dholavira are located at hot and dry climates and do not evidence double season cropping. However, evidence from Harappa and Rakhigarhi suggested that both regions were suitable for double or multi- season cropping, as discussed in table 28.

Subsistence	Variable	Mohenjo Daro	Harappa	Rakhigarhi	Dholavira	Ganweriwala
Double cropping	Y/N/U	N	Y	Y	N	U
Single cropping		Y	N	N	Y	U
Summer crops		N	Y	Y	Y	U
Winter crops		Y	Y	Y	N	U

Type of variable

Y = Yes

N = No

U = Unknown

Table 28. Variables among subsistence of the five major cities

7.2.1 Special production

Several types of specialised products including standardised pottery, production of baked bricks, metallurgical work, seal production, and bead making are known socio-cultural markers of the urban period. The people of the Indus society also used a large quantity of semi-precious and precious stones, such as chert, jasper, jade, limestone, rock crystals, amazonite, lapis lazuli, turquoise, and quartz. I focus on the special production of stoneware bangles, seals, and miniature figurines to compare the large urban centers.

Stoneware bangles

Stoneware bangles have been discovered in large urban centers only (Vidale, 2000). Stoneware bangles were made from different materials that required technical expertise (Wright, 2010). Most of the stoneware bangles were produced with refined clay and were fired using controlled temperatures that required skill (Blackman, et al., 1989). Stoneware bangles are very special and limited in number (Vidale, 2000). These were found in Mohenjo Daro, Harappa, Dholavira, and Ganweriwala.

Seals

Seals and clay tablets were discovered abundantly in the Indus society urban smaller and larger settlements. They were most abundantly discovered in large urban centers such as the Mohenjo Daro, Harappa, and Dholavira settlements and suggest a signature or identification marker of the urban period (Wright, 2010). The Indus society seals reflect upon a high level of specialised skills and technical knowledge. The manufacturing process of seals involved pyrotechnological techniques. There are several types of seals such as the square, rectangular, oblong, and clay tablets, but most prominent were square engraved seals. Among all these types, the most common are square copper seals with an average size of 2.45 cm; however, the largest seals were 6.35 cm in size. Square copper seals were cut with special stone tools and carved with copper-bronze thin-pointed chisels (Vidale, 2000). After the carving process, the seal was soaked in a chemical solution and then baked as high as 1,000°. With this procedure, the surface of the seal appears whitish or glazed, making the seal more durable (Kenoyer, 1997). Most of these square seals exhibit a unicorn bull on one side.

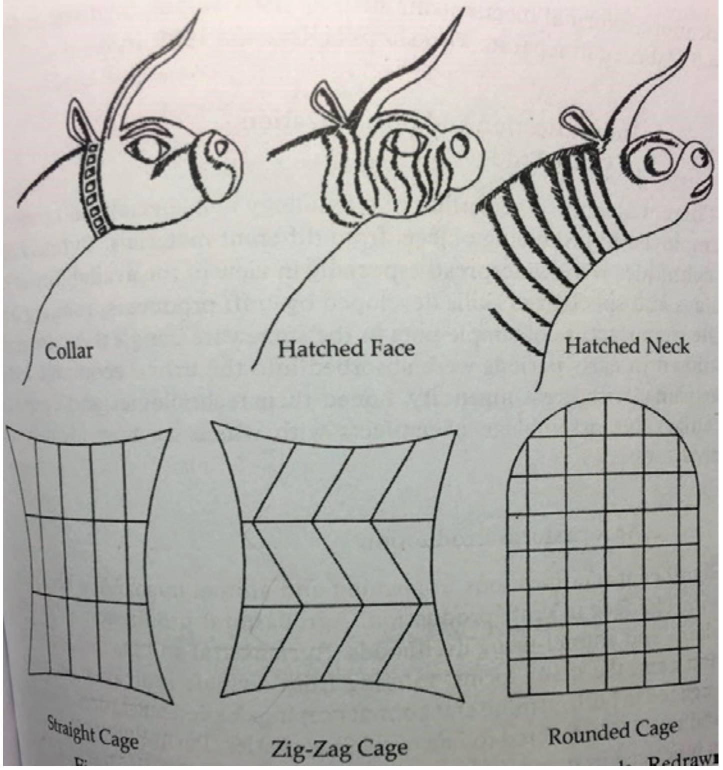


Figure 97. Regional differences of seals, Photo from (Rissman, 1989)

A study of seals by Rissman from the Harappa and Mohenjo Daro settlements (Chanhu Daro and Kalibangan were also included) identified some stylistic variabilities in these square seals (Rissman, 1989). Rissman has identified stylistic variabilities on the head, neck, collar, and ear patterns of the unicorn bull. He found that some seals depict a straight cage on the neck of the unicorn bull, but some have a vertical rectangle or a zigzag cage, while others have a rounded cage as shown in figure 97.

Rissman concluded that the seals with the hatched face and zigzag cage were the most popular at the Harappa settlement, and the seals with the collared neck with a straight cage were found at the Mohenjo Daro settlement. Rissman suggested that these variations might represent different schools of producers at regional levels. However, further studies are needed.

From Ganweriwala settlement, two clay tablets and one copper seal have been discovered (Masih, 2018; Gulzar, 2020). The clay tablets represent similar features of the urban period, such as writing discussed in chapter 4. The copper seal is square, but unfortunately, it is defaced and the motifs are not clear (for more detail, see Masih, 2018).

Human figurines

Human figurines are a fascinating art of the Indus Urban period that reflect the socio-cultural traditions. Human figurines have been discovered in different sizes, styles, and genders.[6] Mohenjo Daro and Harappa are two main centers from where human figurines were retrieved.

Figure 98. Female figurine with fan-like headdress from Mohenjo Daro, Photo from Wikipedia

From the Harappa settlement, two male torsos were discovered: one made of red jasper, and the other with grey stone. The red jasper torso is 9.5 cm long. But, it does not provide a clear picture of the male because the head and arms are missing, and it stands on broken legs. Only the body and genitalia are protected. The other grey stone torso was found in Mound F in the vicinity of a granary. It is 9.9 cm long, but its head, legs, and arms are missing; however, it represents a clear dancing posture.

At Mohenjo Daro, two bronze dancing girl statues, a statue of a king priest, and a seated man have been discovered, but it has been suggested that they belong to a later period (Possehl, 2002).

Another type of female figurine was discovered from Mohenjo Daro, Harappa, and Ganweriwala. This figurine represents a distinct type of female with a fan-like decoration at the back of the head. The body of the figurine is adorned with jewellery, a neck band, a girdle around the waist, and the dress looks like a miniskirt. These figurines were discovered from the urban period of Mohenjo Daro, Harappa, and Ganweriwala.

Two female figurines were discovered in Ganweriwala settlement.[7] Figurine 1 consists only of the body, the arm, and head; the legs of the figurine are missing. The neck of the figurine represents five hanging leaflet-type necklaces. This design of the necklace is similar to the figurine discovered from the Mohenjo Daro settlement. However, it does not represent a waist girdle or head fan, as shown in figure 98.

6 Male, Female, and transgender or unidentifiable figurines

7 Discovered in 2007 placed at the Harappa reserve collection

Figure 99. Figurine 1 from Ganweriwala

Figure 100. Figurine 2 from Ganweriwala

Figurine 2 in figure 100 represents the head, face, and breasts of the female, but other parts of the body are missing. The facial expressions are broad, round-shaped eyes, and nose that are quite similar with the figurine found at the Mohenjo Daro settlement, as shown in figure 98. The lips are faded, and on both sides of her face closer to ears, she is wearing a basket-like container. There is not a clear picture of her head decorations, but it seems she is wearing a similar fan-like head dress, like Mohenjo Daro's female figurine.

The special figurines from the Harappa, Mohenjo Daro, and Ganweriwala settlements represent socio-cultural practices. The male sculptures from the Harappa settlement are rare and are not found at any other settlement (Possehl, 2002).

From Dholavira, a stone lizard and a seated male were discovered (Singh, 2008). The seated male figurine looks similar to the seated man from the Mohenjo Daro settlement, but it is poorly preserved. There is no evidence of female figurines with head dresses at the Dholavira settlement.

From Rakhigarhi, terracotta figurines have been discovered, but no female figurines with a special head dress or any stone sculpture are evident yet.

7.2.2 Bricks

During the urban period, the use of baked bricks was a common practice, and almost all large settlements were largely constructed using a standard size of baked brick. Only the Dholavira settlement does not show evidence of any types of bricks, as it was largely constructed using finished stones. Still, bricks are the symbolic material of Indus society masonry and were available in large quantities, from the archaeological evidence. Several types of bricks have been discovered from Indus urban centers, which were used for different structures. For example, at Mohenjo Daro, wedge-shaped bricks were used for building wells.

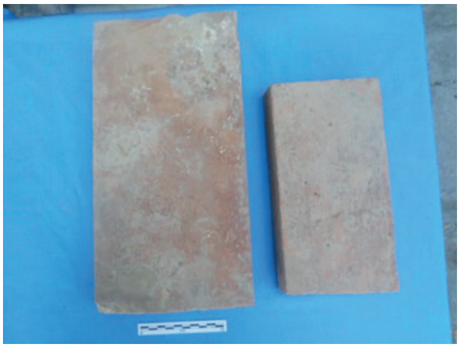


FIGURE 101. Two different size bricks from Harappa both represent the 1:2:4 ratio

FIGURE 102. Bricks from Ganweriwala settlement

The production of highly skilled bricks with a standard ratio might represent centralised control over production. Although there are regional variations among the sizes of the bricks, they all carry the standard ratio, as discussed in earlier chapters. For example, a standard Mohenjo Daro brick is 7 x 14 x 28 cm, but bricks from Ganweriwala are 6.5 x 13.5 x 26.5 cm with a 3,243 g weight. This shows that although the bricks from the surface collection of Ganweriwala settlement contain different size proportions, they maintain the standardised value of 1:2:4. Thus, we can understand that the size proportion of the bricks is a regional variability, but standardisation was maintained.

7.3 Comparison of mnemothecnic devices and Indus script

Indus script is the most complex form of writing that is yet to be deciphered. During the Urban period, writing was a vital tool for the recording, processing, and transmitting of information. Writing has been discovered within all large urban centers on seals, pottery, and clay tablets. But there is no evidence of writing in the form of documents, for example, on paper or papyrus rolls. Approximately 3,700 inscribed objects have been discovered from the major Indus urban settlements.

The language script does not evidence any regional variations during the urban period. The script constitutes approximately 400 to 450 basic signs, known as logosyllabic, and reads from right to left. According to Possehl's table[8] of inscribed material, from the Mohenjo Daro settlement a total of 1,540 artefacts were discovered, and from the Harappa settlement, 985 artefacts were discovered.[9] From Harappa, the largest quantity of clay tablets with inscriptions has been discovered. Around 272 mini objects have been discovered from Harappa. From Ganweriwala settlement, two clay tablets and several ceramics with graffiti have been discovered (discussed in Chapter 4). Dholavira and Rakhigarhi also shared a similar script. A shared administrative language over a vast geographical region also emphasises centralised control.

7.4 Comparison of urban scales

The comparison of settlement locations, population density, architectural complexity, and estimated sizes exhibits a hierarchy at the regional level. Based on this analysis, I have developed four different scales of these large settlements: scale A, scale B, scale C, scale D. These scales represent the regional scales of the settlements. However, the urban function of these settlements are similar, and they all were

8 Possehl 2002 pp127

9 These number may vary based on new data

the administrative units of the region they belonged to. Thus, the local scales of these settlements are similar; however, regional scales are different, which constitutes a complex urban infrastructure of society.

Based on the scaling model, scale A, cities were mostly concerned with inter-regional trade and exchange, along with complex regional control. Scale B cities were mostly engaged with regional work. Scale C cities were gradually developed from villages into cities with small workshops for producing crafts for scale A, cities.

7.4.1 Scale A

Scale A, settlements represent the most complex form of settlement planning, architecture, geographic location, and economic activity. The size of these settlements can be between 150 to 300 ha. This type of settlement was deliberately planned around 2700 BCE. The archaeological evidence from the settlements show they were involved in a trade and exchange network with neighbouring countries. Mohenjo Daro is the only settlement that exhibits scale A.

7.4.2 Scale B

Scale B, settlements are those that were developed gradually from small village-type settlements. The size of these settlements can be between 60 to 150 ha. The architectural complexity, density, and economic activities are slightly different from scale A, settlements. A crucial indicator is their location, as they are located around the local rivers that do not have direct access to the Arabian Sea, such as the Harappa, Ganweriwala, and Rakhigarhi settlements. These settlements might be much involved in regional trade and networks rather than inter-regional networking.

7.4.3 Scale C

Scale C, settlements are medium sized and less complex compared to scale A and scale B. The size of these settlements can be between 20 to 60 ha. These were the subsidiary settlements of the large urban centers and might be the production centers of different crafts. Dholavira is an example of scale C.

7.4.4 Scale D

Scale D, are mainly food producing settlements located around the vicinity of scale A, scale B, and scale C settlements. They were the backbone of the Indus society. These were less developed architecturally, and they were constructed with mud bricks. The Cholistan region is the best example of scale D settlements, as discussed in Chapter 4. Scale D settlements had major contributions towards the agriculture and socio-economy of Indus society.

7.5 Comparison of Urban functions

7.5.1 Mohenjo Daro

Mohenjo Daro's size, density, planning, architectural attributes, advanced level of sanitation and hygiene characterise it as an institutional/educational city (Mosher, 2017). The settlement was deliberately planned, and there is no evidence of human occupation before the urban period (Fanke-Vogt, 1994). The present analysis elaborates on the fact that the Mohenjo Daro settlement was the major way to establish and maintain networking with the near eastern societies such as Mesopotamia.

7.5.2 Harappa

The architectural features, location, and density show that the settlement was the major urban center of the Upper Punjab region and controlled its hinterland. Around 2450 BCE, socio-economic activities developed, such as craft technology, bead making, and seal production. Some of the craft activities, such as agate, lapis lazuli, blue-glazed faience, drilled carnelian, and serpentine suggest that the settlement was involved in long distance[10] trade with Gujarat and Afghanistan (Meadow, et al., 1999).

7.5.3 Ganweriwala

Ganweriwala's surface study, location, size, and socio-cultural characteristics emphasise its importance regarding being the administrative urban center of the Cholistan region.

7.5.4 Dholavira

Dholavira's architecture, size, and location reflect its importance as a trade and exchange center or a ceremonial or resort type of Urban center (Possehl, 2002). An important observation about its architecture is that the earliest period of occupation was around 2650 BCE, like Mohenjo Daro. It can be a deliberately planned urban center. Possehl (2002) described it as a caravanserai used for communication among traders.

7.5.5 Rakhigarhi

The knowledge of the Rakhigarhi settlement is limited. However, based on the present analysis, it is clear that the Rakhigarhi settlement was the regional urban center of the Ghaggar River region. Thus, Ganweriwala and Rakhigarhi were two major urban centers that controlled trade and exchange around the Ghaggar-Hakra system.

7.6 Discussion and summary: Indus urban Infrastructure

Based on the following comparison the major urban settlments show greater variabilities and lesser simmilarities discussed in the table 29. The tables shows the major varibilities.

Features	Mohenjo Daro	Harappa	Dholavira	Rakhigarhi	Ganweriwala
Environment	Semi-arid, arid	Tropical forest	Semi-arid	Tropical forest	Arid
Rainfall	70-100 mm	278 mm	262 mm	395 mm	137 mm
Connected Rivers	Lower Indus	Ravi	No river	Ghaggar	Hakra
Urban development	2600 BCE	3600 BCE	2650 BCE	3200 BCE	3800 BCE
Settlment plan	Semi grid plan	Not clear	planned	Not known	Planned at right angles
Divisions	2	2	3	Not known	2
Fortifications	Platform	Walls	Walls	Not known	Not known
Distinct architecture	Great bath	Working plat-forms	Castle, Reservoir	Burials	Not known

Table 29. Comparison of major variabilities

Other variabilities can be seen in the settlment size and density, the social impact, built environment and socio-economic features as discussed in table 30.

10 Afghanistan and Gujarat have evidence of Indus society culture. Because of this fact, it must be regional trade not inter-regional which is differentiated by sea routes like Mohenjo-Daro and Bahrain or Oman

Attribute	Type of variable*	Mohen jo daro	Harappa	Rakhigarhi	Dholavira	Ganweriwala
Settlement size	M	200 ha	150 ha	60 ha	45 ha	67 ha
Population	M	50000	30000	12000	9000	13500
Social Impact						
Monument	P/A/U	P	P	A	P	U
Burials	P/A/U	A	P	P	A	U
Temple	P/A/U	A	A	A	A	U
Civic architecture	S	P	P	A	P	U
Shops	S	3	1	0	2	0
Craft Production	S	3	3	1	2	3
Built Environment						
Infrastructure	P/A/U	P	P	A	P	P
Citadel area	M	8 ha	10 ha	A		U
wall width	M	A	15 M	A	11.6 M	U
Citadel elevation	M	45 m	45 m	A	18 m	U
Bricks	M	010204	010204	010204	A	010204
Water tank	M	12x7x2	A	A	95x10x4	A
Socio economic features						
writing	P/A/U	P	P	P	P	P
Clay tablet	P/A/U	P				
Seals	P/A/U	P	P	P	P	U
Stretegic location	X/Y	X	Y	Y	X	X

Type of variable

M Quantitative measurement of calculation

P/A/U present absent unknown

S (measurement scale) 1(low) 2(moderate) 3(high)

X Close to river or sea

Y Situated on alluvial plain

Table 30. Major variables among five large Indus urban settlements

The results of the above mentioned discussion demonstrate that major variabilities exist among the five known major Indus settlements. The variabilities can be traced in environment, settlement plans, fortifications, and architecture. Five settlements were located at wider distances that had different environments and landscapes. The environmental and landscape difference impacted the subsistence practices at each settlement, as discussed in 7.2.

The fortifications of Mohenjo Daro, Harappa, and Dholavira were different, as only Dholavira had complete evidence of a fortification wall around the settlement. All settlements were developed during different time periods; only the Mohenjo Daro and Dholavira settlements were deliberately planned around 2600 and 2650 BCE, respectively. However, scale B settlements developed from small villages to larger urban centers.

Mohenjo Daro and Dholavira have a semi-grid type settlement plan. Harappa was not planned. The archaeological evidence suggested that Harappa was gradually developed from 3800 BCE to 2600 BCE. The gradual development of the settlement set several irregularities in the plan, and several structures were added during different time periods, such as the working platforms discussed earlier. However, the topographic features of Ganweriwala present similar town planning, like Mohenjo Daro. The Upper town is to the north and the Lower town is situated to the south, which are divided by a narrow depression.

Settlement division is also different. Mohenjo Daro has two clear divisions of the city followed by a deep depression. Upper town is situated towards the north, and Lower town is towards the south. Dholavira has a distinctive plan divided into three divisions, and architectural structures covered the four sides of the settlement.

All of the settlements have some distinct structures, as shown in table 30. The Indus society is considered to lack monumental architecture, such as palaces or temples. However, the present analysis shows distinct structures. These structures are not similar to the pyramids of Dynastic Egypt or the ziggurats of Mesopotamia; they are distinct and unique. I have two explanations of this phenomenon:

1. Advanced architectural standards
2. Limited scale excavations

The architecture of the Indus society is more advanced and complex than any other ancient societies. Thus, it is understood that they might experience different monumental architecture compared to the Egyptian pyramids or Mesopotamian ziggurats. The great bath from the Mohenjo Daro and the castle from Dholavira represent the form of symbolic architecture, as discussed in Chapter 5.

Another possible reason is the unexplored regions and settlements, such as Ganweriwala. Future excavations can contribute to the discovery of monumental architecture. Structural differences from the Upper towns of these three urban centers emphasise that the settlement planning was not controlled by a centralised authority; they were planned regionally.

The result of the above discussion shows that five major Indus urban centers are of a different type and nature that exhibit few similarities at an abstract level but have greater variabilities. Major variabilities existed in architecture, planning, and size, as shown in table 29. Similarities existed in the form of the bricks' standard size, writing, divisions of the settlements, and among specialised crafts such as figurines.

The variabilities suggested that all settlements had different urban scales and urban functions. The five major urban centers have similar local scales; however, at a regional level, they have different scales and constitute the urban infrastructure of the Indus society that functioned through mutual interactions.

CHAPTER 8

Comparison of the environmental and urban setting of the Indus society and Mesopotamia

Ancient Mesopotamia is one of the major urban societies that represents the earliest complex form of human settlements. It developed around the Tigris and Euphrates rivers in Iraq (Wilkinson, 1994). The available archaeological data suggests that around 3400 BCE, several city-states developed in different regions of Mesopotamia known as North or Upper Mesopotamia and South or Lower Mesopotamia (See details in 8.2).

In this chapter, the major aim is to analyse the similarities and differences among two macro-regions: Mesopotamia and the Indus society. To pursue this goal, the two large settlements from each region are compared: Uruk from Mesopotamia and Mohenjo Daro from the Indus society. Their urban attributes such as city planning, architecture, and environment are compared. Further, the settlement patterns from the Cholistan region of the Indus society are compared with the Diyala plain region of Mesopotamia. The results show the similarities and differences of urban development and processes among two regions.

8.1 Environment of Mesopotamia

Mesopotamia is located on the alluvial plains between the two rivers Tigris and Euphrates. Both rivers rise from the mountainous terrain of eastern Turkey, where they are fed by spring meltwater and winter rains. To the east, the region is followed by the uplands and mountains of Iran, and to the west by the arid deserts of Arabia and Syria.

To the north and east, the region is bounded by the Zagros Mountains. To the southeast, it is followed by the Arabian plateau. The flat alluvial plain is a large basin composed of soils and sediments eroded from the uplands of Iran, Turkey, and Syria, which are brought down by the rivers and their tributaries (Wilkinson, 2003). The plains of Lower or South Mesopotamia consist of a variety of water channels or canals (called levees), flood basins, and marshes. The channels of these canals, flood basins, and marshes can be subdivided into single or multiple branches (Verhoeven, 1998)

Generally, Mesopotamia divided into Upper and Lower plains. Northern Mesopotamia has a semi-arid climate with a hot, dry summer and a cooler autumn. In contrast, southern Mesopotamia has an arid and dry climate, even in cooler months. The average rainfall is less than 200 mm/year, which is insufficient for crop production and agriculture (Wilkinson, 2000). The central and lowlands of Mesopotamia are arid with low rainfall, but the irrigation from river waters allows crops to grow. The agriculture is dependent on the canal irrigation system developed from the river water. With the canal irrigation system, the natural fertility of the Lower Mesopotamian plains increased and provides a high rate of crop production as a result.

FIGURE 103. Setting of Mesopotamia, Map source: Wikipedia

8.2 Background to the urban setting

Within the available sources, it has been suggested that around 8000 BCE, nomadic and hunter-gatherer communities started harvesting and agriculture practices. The communities practicing agriculture established the earliest farming settlements or villages. These settlements were few in number and less complex architecturally. These early farming settlements include, for example, Jericho, Tell Abu Hureyra, and Catalhöyuk. Around 7000 BCE, these farming communities were scattered throughout the plains of the Tigris and the Euphrates, from the Southern Levant across to Northern Mesopotamia down to the Persian Gulf.

These communities started to develop a complex type of settlement consisting of more than one dwelling. Clusters of mud-brick houses and different pottery styles emerged. The stylistic variations of pottery represent the different periods assigned to the settlements. The small settlements have a complex chronology, and the general cultural developments, known as the Hassuna, Samarra, Halaf, and Ubaid periods, are from 7000 to 5000 BCE, subsequently.

Around 6500 BCE, early farming communities evolved into complex societies. During the late 4th and early 3rd millennium BCE in Southern Mesopotamia, a massive portion of the population settled in large complex settlements. Around 3000 BCE, the settlements developed and set new, complex patterns of urban development. Because of the urban developments in the region and the complex form of the settlements, the Mesopotamian region was often known as the heartland of cities (Adams, 1981). In this present study, I refer to this period as the urban period (3200–2200 BCE) of Mesopotamia, when urbanism developed within the rise of social complexity. However, some recent explorations at the Tell Brak settlement have suggested that urbanisation had already developed in Northern Mesopotamia by around 5000 BCE. The excavations around the Tell Brak settlement show that around 5000 BCE, Tell Brak was a large urban settlement of 130 ha (Ur, et al., 2011). However, around this period urbanism in Southern Mesopotamia was less developed compared to Northern Mesopotamia, so more work is needed for a clear understanding of the urban period of development at Northern Mesopotamia.

8.3 The urban setting of Mesopotamia

The settlement data from Mesopotamia is derived from a limited set of surveys. One of the most well-known systematic surveys was conducted by Robert McCormick Adams and a group of his students in the decades between the 1950s and 1970s (Adams, 1966; Adams, 1981). They surveyed substantial portions of Mesopotamia (Algaze, 2008). Archaeological evidence suggests that multiple interacting urban settlements existed throughout Uruk period, and all of them were located alongside water channels and positioned at the apex of variegated settlement structures. This settlement pattern had already been developed by the first quarter of the 4th millennium BCE discussed in the previous section.

Generally, development within the urban period 3200-2200 BCE of Mesopotamian society is divided into six main socio-cultural periods, as described below. The areas of focus are the 2900–2100 BCE Urban Period planning and developments that are known as the Early Dynastic I, II, III, Akkadian, and Ur III periods (approximate chronology based on radiocarbon dating) (Pollock, 1999). This chronology, however, is used for the Southern Mesopotamian region, as discussed earlier.

Time Period	Description
5000 BCE	Ubaid
4000 BCE	Uruk, (Early, Middle, Late) urban societies started to emerge and increase the number of settlements (Adams, 1981).
3100 BCE	Jemdet Nasr (Jemdet Nasr is a cultural assemblage and is named on the type-site that is the earliest example of Sumer cities. Jemdet Nasr culture accomplished geometric and figurative art on ceramics and clay tablets. This period is also associated with the formative stage of cuneiform writing that preceded the Dynastic period.)
2900 BCE	Early Dynastic I, II, III city-states, writing emerged.
2350 BCE	Akkadian (The conquest of the Akkadian king, Sargon, brought the unification of Mesopotamian city-states and is referred to as the Akkadian period or Akkadian Empire. During this period, the city of Akkad was the main political seat and the Akkadian Empire became more influential in the neighbouring region of the Arabian Peninsula.)
2100 BCE	Ur III (Around 2100 BCE, the ruler of Akkad City lost control and the kings of Ur took command of the region.)

2900–1800 BCE is considered to be the primary period of urban processes and development in Southern Mesopotamia. Around 2900 BCE, Southern Mesopotamia developed settlement complexity. The social transformations are generally known as the origin of city-states in Southern Mesopotamia. There was no single unified state; Southern Mesopotamia was divided into several city-states. The settlements present a nucleated type of pattern with a visible hierarchy of village, town, and city; they can also be described as smaller, intermediate, and larger settlements within a radius of 15 to 30 km^2 (Adams, 1981). The largest cities were surrounded by intermediate settlements that were further surrounded by a cluster of villages. The three-tiered hierarchy of settlements represents the socio-economic and political structure of the society. The rulers who controlled state affairs resided in the larger settlements. The second class of rulers resided in the intermediate settlements or towns and controlled the grain production and subsistence of the village communities or smaller settlements. This three-tiered hierarchy pattern was part of the socio-political ideology in which the urban period of Mesopotamia had been planned and developed.

A large urban settlement was internally divided into separate zones: the main street, smaller alleys, markets, residential complexes, ritual complexes, palaces, and a canal system. Trade and communications played vital roles in the development of these early city-states of Mesopotamia (Algaze, 1993). These city-states were controlled and operated via a complex socio-political system that is beyond the scope of this present study.[11]

The alluvial plains of Southern Mesopotamia had more than two dozen major cities around 2900 BCE with different sizes that changed over time. Some of important settlements are Babylon with its maximum extension of (800 ha), Uruk (550 ha), Lagash (440 ha), Larsa (350 ha), Girsu (350 ha), Nippur (220 ha), Isin (120 ha), and Ur (70 ha), as shown in figure 104.

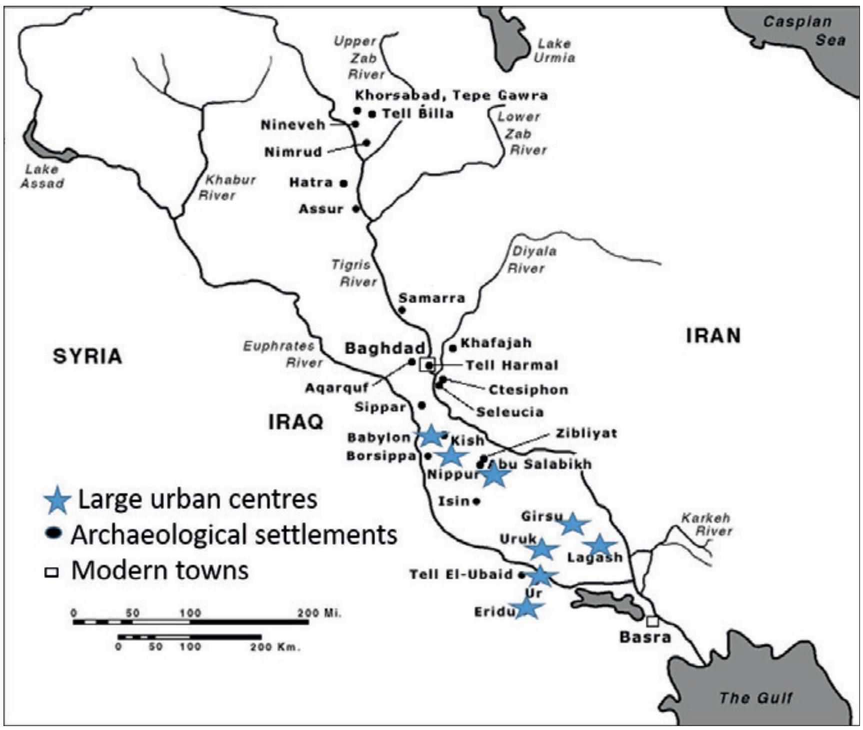


Figure 104. Mesopotamian city-states, Map source: Wikipedia and modified by the author

Cities were located closer to the banks of major rivers and canals, as shown in figure 104. A few cities, such as Uruk, Nippur, and Babylon, had canals within the city that divided them into two parts. The cities had an irregular layout, following the terrain of irregular agglomeration, of buildings and winding roads. Some cities had a circular or square layout with straight streets and regular buildings. The cities also had some standard structures, such as a defensive wall, a temple, and palaces. Palaces and temples both formed the administrative and economic activities. The major cities and several smaller cities

11 The term city-state appeared in the late nineteenth century and was used by European Scholars to refer to the Greek and Roman settlements (Burke, 1986). It generally referred to the phenomenon of a State and a particular type of settlement Pattern that was politically independent, small, territorial based, characterized by a capital city adjacent with socially and economically integrated hinterland (Rihll & Wilson, 1991). Later it became a well-established term to address the Mesopotamian and other ancient settlements from different regions of the World (Wright, 2010).

were constructed on gradually accumulating mounds or tells of mud bricks. Tells are artificial mounds composed from the debris of previous buildings and garbage.

For a comparative analysis with Indus urban process and development, I have chosen Uruk City and compared it with Mohenjo Daro, one of the major Indus cities. The internal layout and structures of Uruk from available sources are analysed and compared. In addition, the Diyala River's settlement pattern is also compared with the Cholistan region's settlement pattern. The analysis of the regional settlement patterns and settlement planning, such as layout, structures, and architecture, infer the basic variability of urban infrastructure between the respective societies, as discussed below.

8.4 The Diyala plain regional survey and settlement pattern

Robert McC Adams established settlement patterns around the bank of the River Diyala of the Mesopotamia region and compared settlement hierarchy and subsistence with the Maya region (Adams, 1966). I will present his results from the Diyala plain survey and compare them with the results from the Cholistan regional settlement pattern of Indus society, discussed in Chapter 4, and examine the variabilities among these two macro-regions at a general level.

The archaeological surveys on the Diyala region started in 1937 and were completed in 1958 by Dutch Egyptologist Henri Frankfurt (Wilkinson, 2003). In 1965, Adams used the intensive information about surface reconnaissance and maps for recording changes in settlement patterns through a succession of five major phases divided into 15 periods of irregular length. My focus is on the settlement distribution of 4000 to 2000 BCE, and I incorporate only these periods into my study.

Adams divided the Diyala plain settlements chronologically as the Ubaid period settlements, the Warka (Uruk) and Protoliterate periods, the Early Dynastic period (4000–2300 BCE), and the Akkadian and Gutian periods.

I discuss the Early Dynastic and the Akkadian/Gutian period (4000/2300 BCE) settlements to compare the urban period settlements of the Cholistan region.

8.4.1 Setting of Diyala region and settlement patterns (4000–2300 BCE)

The Diyala River is an irregular fan-shaped alluvium originating from the Zagros Mountains of the Hamadan City of Iran. It descends through the mountains and forms the border between Iran and Iraq. It runs from the Hamrin Mountains towards the southwest, and just below Baghdad City, it joins the Tigris River, constituting an area of 445 Sq. km. The climate of the region is arid with two main seasons. There is a summer with intense heat from May to early October, with an average temperature of 43°. From November to March, there is winter with an average temperature between 24° and 5° (Adams, 1966).

During Early Dynastic periods, the settlements became more developed and complex. There is a record of a total of 97 settlements of various sizes: 0 to 4 ha are villages, 4 to 10 ha are small towns, and 10+ are large towns (Adams, 1981). Three large towns Tell Asmar, Tell Agrab, and Khafajah have fortification walls. The settlements have the elaborative feature of temple architecture. There is no evidence of any palacelike architecture until the end of the Dynastic period of the Diyala plain region. Although in southern Mesopotamia, monumental architecture has been excavated at the sites of Kish and Eridu, which belong to Early Dynastic III and late Dynastic II periods. The absence of monumental architecture emphasises that the process of urban development was less complex than in South Mesopotamia.

Indus urbanity was much more developed as compared to Mesopotamia because of planning, size, and standardization.

Village (less than 4 ha)

There were 31 villages settlements however, Adams mentioned the site numbers in his book that I use here (for more details, see Adams, 1966, p. 39):

9, 14, 18, 31, 45, 46, 56, 77, 80, 102, 105, 122, 158, 160, 176, 192, 214, 221, 225, 259, 261, 262, 270, 276, 278, 297, 298, 341, 342, 344, 345, 350, 354, 357, 362, 364, 368, 370, 372, 381, 396, 419, 429, 433, 441, 450, 458, 463, 465, 489, 517, 521, 530, 531, 534, 556, 563, 576, 579, 581, 599, 633, 634, 637, 648, 818, 835.

Small towns (4–10 ha)

Tell ousha, Tell Yahudi, Tell al Dhahab, Abu Salabikh, Tell Abu Tabbin, Tell al Halfayah, Tell Halawa, Tulul Shilbiyat, Abu Khusan, Saghir, Tell Seb, Abu Obayya, Tell Rishad, Tulul Mujaili, and Tell al Lami.

Large towns (more than 10 ha)

Abu Rasin 13.5 ha, Tell Dhiba 10.6, Tell Asmar, Tell Agrab 10.8 ha, Abu Zambil, Tulul abu Yiwalik, Khafajah, Tell abu Jawan, and Tell abu Dibis.

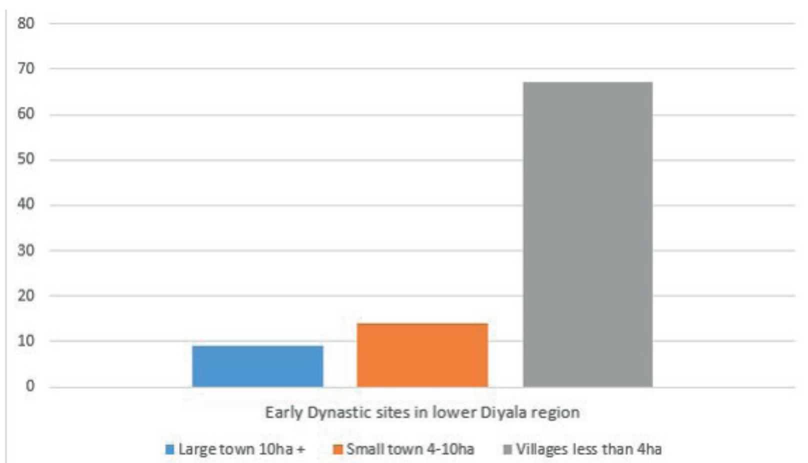


Figure 105. Settlement hierarchy of Early Dynastic settlements at the Diyala plain region

The settlement hierarchy of the Diyala plain region shows a different pattern of urban development than the Cholistan region, as discussed in Chapter 4. The Cholistan region of the Indus society has more dense urban development, and the settlement number grew from 2600 to 1900 BCE. However, the urban development process at the Diyala plain region was less dense from 2600 to 1900 BCE. The Cholistan regional survey resulted in a five-tiered hierarchy of settlements, but the Diyala plain surveys resulted in a three-tiered hierarchy. The sizes of the settlements of the Cholistan region are greater than the Diyala plain settlements, which are given in the chart below. The sizes are based on tiered hierarchy also have regional variations, such as the settlements of 4 to 10 ha are small towns in the Diyala region of Mesopotamia, but 5.1 to 10 ha settlements are categorised as large villages in the Cholistan region of the Indus society, as discussed below.

Small village	0.1–5 ha
Large village	5.1–10
Small town	10.1–20
Large town	30 +
City	80+

Cholistan region settlement hierarchy

Village	0–4 ha
Small town	4–10
Large town	10+

8.4.2 The Diyala plains settlement hierarchy

The Diyala region of Mesopotamia had the Diyala River as a major source of water and canal systems, but the region does not exhibit any large size settlements with more than 50 ha in size. The Cholistan region has one larger settlement known as Ganweriwala with an estimated size of 67 ha.

The variability of the urban development process suggests that both regions had different socio-economic processes and urban development. The Cholistan region seems greater in socio-economic and urban development than the Diyala region. In the chart below, I have compared the number of settlements of both regions. The definition of village, town, and city of both regions are different, as discussed above. I took the number of settlements according to the above-mentioned chart, but in the case of the Cholistan region, I deliberately counted the small and large villages as villages and small and large towns as towns shown in figure 106.

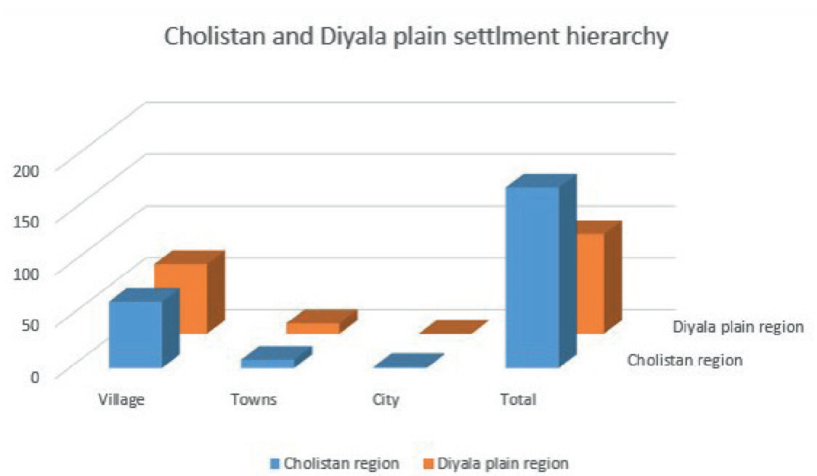


Figure 106. Comparison of settlement hierarchy of the Diyala region and the Cholistan region

The settlements from the Cholistan region present variations in number and size during different time periods, with an increase in number until around 2400 BCE. There was total abandonment of settlements around 1900 BCE. However, the settlement pattern from the Diyala region does not show any variations, and there is a continuity of settlements in the proceeding periods as well.

8.5 Uruk settlement of Mesopotamia

Uruk was one of the largest cities of Southern Mesopotamia, dated to an early part of the Dynastic period (2900–2300 BCE). It is located on the eastern bank of a dried up channel of the Euphrates, about 250 km south of Baghdad, the capital city of Iraq. The city of Uruk was a major urban center in the mid-4th millennium BCE, and it was critical to the development of cuneiform writing around 3300 BCE.

During the Early Dynastic I period (2900 BCE), Uruk was a 400 ha settlement. Adams has estimated that it was inhabited by approximately 40,000 or 50,000 people (Adams, 1981). The estimations of population density usually range between 100 and 200 persons/ha, with a maximum figure of just under 400 persons/ha, as already discussed in 7.1.2 (Pedersen, et al., 2010).

The city originated as a small village which gradually grew into a larger settlement (expand this discussion). Archaeologists gradually divided the chronology of Uruk into the seven periods listed below.

1. Uruk I (2600–2100 BCE)
2. Uruk II (2900–2600 BCE)
3. Uruk III Jemdet Nasr period (3100–2900 BCE)
4. Uruk V–IV Late Uruk period (3400–3100 BCE)
5. Uruk IX–VI Middle Uruk period (3800–3400 BCE)
6. Uruk XVI–X Early Uruk period (4000–3800 BCE)
7. Uruk XVIII–XVI Late Ubaid period (4800–4200 BCE)

Figure 107. The location of Uruk in modern-day Iraq, Map source: Wikipedia and redrawn by author

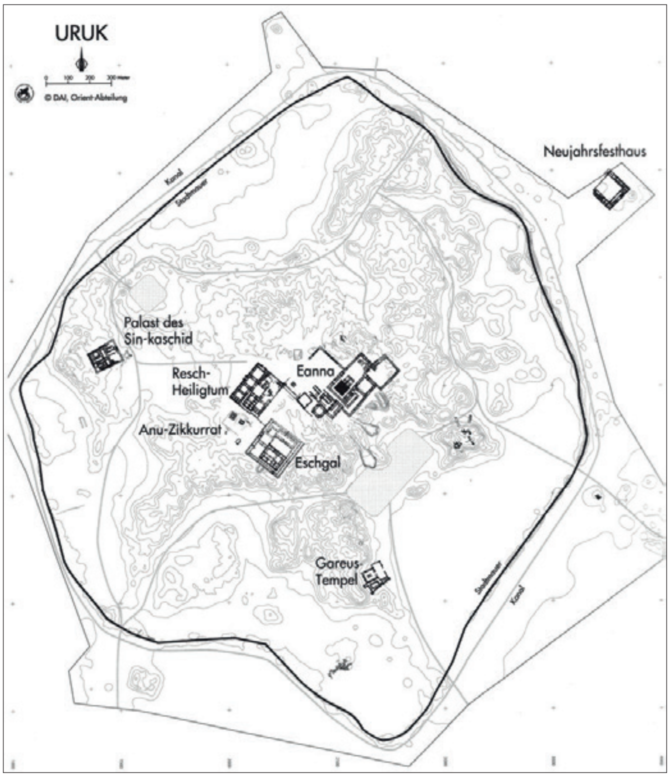


FIGURE 108. Uruk settlement, Photo from Wikipedia

The structural developments proceeded over different time periods at Uruk settlements. One of the major reasons is the use of mud bricks in construction. Mud-brick structures are demolished seasonally due to rain, and they are reconstructed directly on the top of the ruins. Therefore, a chronological division of construction is hard to find and to explain in detail.

8.5.1 Comparison of Uruk and Mohenjo Daro urban settlement attributes

The analysis of Mohenjo Daro in Chapter 5 and the examination of Uruk settlement suggest that settlements present different urban attributes. Mohenjo Daro was a systematically planned urban settlement, while Uruk developed gradually from a smaller settlement to a settlement with a large proportion of attributes related to an urban agglomeration. Uruk settlement

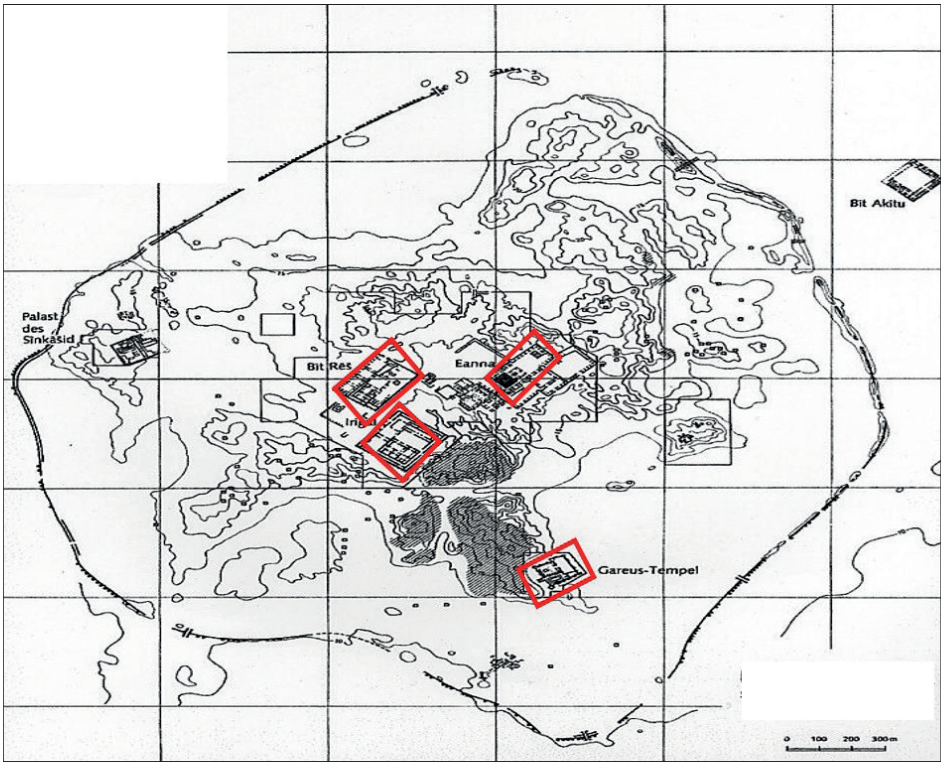


FIGURE 109. Uruk settlement's different districts, Photo from Wikipedia and modified by the author

provides details about social stratification, such as the structures of ritual performance, palaces, and residential structures, as shown in figure 108.

During the Early period of 4000–3800 BCE and the Middle Uruk period of 3800–3400 BCE, Uruk grew to urban proportions. Mohenjo Daro, on the other hand, was a relatively planned city and emerged around 2600 BCE. One can therefore conclude that Uruk developed much earlier than Mohenjo Daro.

By the Late Uruk period of 3400–3100 BCE, Uruk was about 100 ha in size and was the largest settlement in Southern Mesopotamia. In this period, the city had two distinct complex districts, named the Eanna District and the Kullaba or Anu District. The Eanna District was dedicated to the city goddess, and the Kullaba or Anu was dedicated to the sky god An. Both districts were dedicated to religious practices. The features of god worship and temple structures are not clear at Mohenjo Daro.

Around 2900 BCE, the size of Uruk settlement expanded to 400 ha and became ruled by several rulers. One significant name is King Gilgamesh, who appears superhuman in later epics. The 'Epic of Gilgamesh' claims that, around 2700 BCE, King Gilgamesh constructed the wall around the city (Pedersen, et al., 2010). This claim emphasises the idea that, at initial stages, the settlement was not fortified.

The district of Kullaba or Anu had a temple from the Ubaid period that grew to a 13 m high tower by 3000 BCE. The temple had a tripartite plan consisting of a central room with an offering table and fire altar. The central room was flanked by a row of smaller rooms. The district of Eanna was situated about 0.5 km east of Kullaba or Anu. The buildings were frequently demolished and rebuilt in these districts. Most of the structures are associated with temples. The demolishing and rebuilding of structures were associated with the struggles of power and use of resources (Nissen, 2003).

The urban structures at the Mohenjo Daro settlement were relatively planned, but the class division is less understood. There are no clear structures associated with ritual performances or palaces.

The settlement plan of Uruk exhibits different districts of the city, associated with different temples shown in red rectangles in figure 109. These districts do not exhibit the regularity in plans. But temple structures are the most prominent settlement structures. This type of temple structure is missing at the Mohenjo Daro settlement. The right side of figure 110 shows the settlement plan of Mohenjo Daro, which is very different from Uruk city. Mohenjo Daro shows two different parts of the city with complex structures, but there is no direct evidence of any temple or palace-like structure. The socio- economic inequality and class division is less understood at Mohenjo Daro, and at Mesopotamia, it is clearer.

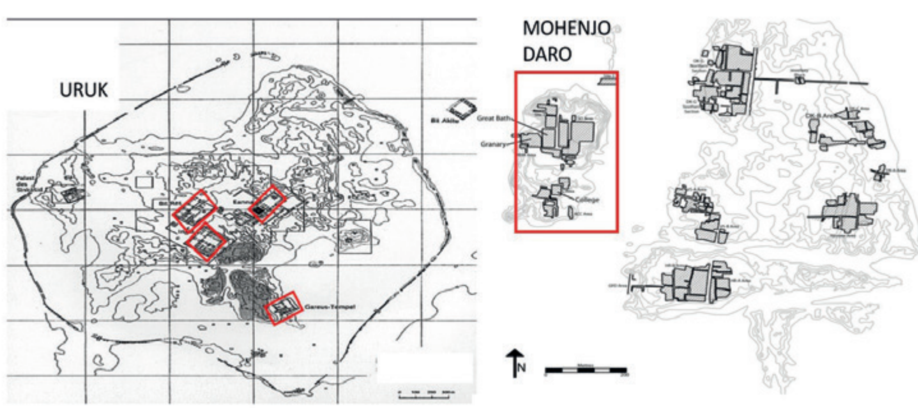


Figure 110. Settlement plan of Uruk from Mesopotamia and Mohenjo Daro from the Indus society

Uruk settlement was fortified with walls on all four sides. Although the fortification at Mohenjo Daro is different, it was fortified using mud-brick terraces, as discussed in Chapter 5. One of the most prominent features of the Mohenjo Daro settlement is its water management system: fresh water wells, sewerage system, and toilets, as discussed in Chapter 5. However, at Uruk there is no evidence of a sewerage system or well system within the settlement. However, they efficiently managed the river water in the form of water channels and used it for irrigation. On the contrary, at Mohenjo Daro, there is no evidence, such as constructing dams or water channels that indicates river water management. The difference between the water management systems clearly indicates that the city planners of both societies had different approaches. For example, hygiene was a dominant concern for Mohenjo Daro planning. At Uruk settlement, however, hygiene was not very important, as there is no evidence of drainage or a toilet system. Uruk settlement had a well-established canal system to irrigate the hinterland for food production. The evidence of a canal system emphasises that food production was a major priority during the urban development process of Uruk settlement. At Uruk settlement, there is evidence of cultivated gardens inside the settlement (Adams, 1966). The Mohenjo Daro settlement does not have any type of cultivation inside the settlement (Jansen, 1987). The lack of agrarian practices inside the Mohenjo Daro settlement demonstrates that it was an industrial urban center in nature. This type of urban center was rare around 2600 BCE, and possibly Mohenjo Daro is the only one to present that uniqueness. Table 31, presents the fundamental variabilities between Uruk and Mohenjo Daro settlements.

Features	**Uruk**	**Mohenjo Daro**
Size	400ha	200ha
General settlement Plan	Unplanned	Relative Planned
Urban development	4000-2200 BCE	2600 BCE-2000 BCE
Fortification	Walls	Elevations
Districts	Several but well known are Eanna and Kullaba	Upper Town, Lower Town
Special architecture such as temples, palace or gardens	Yes	No
Construction Material	Sun-dried Bricks	Baked Bricks
Sanitation and hygiene system	No	Yes
Irrigation canals	Yes	No

Table 31. Major variables among Uruk and Mohenjo Daro

An analysis of the great bath at Mohenjo Daro and in Anu District during Uruk III period suggests different approaches to religious constructions. Anu District during Uruk III period consisted of a ziggurat, altar, stone building, and white temple, as shown in figure 111.

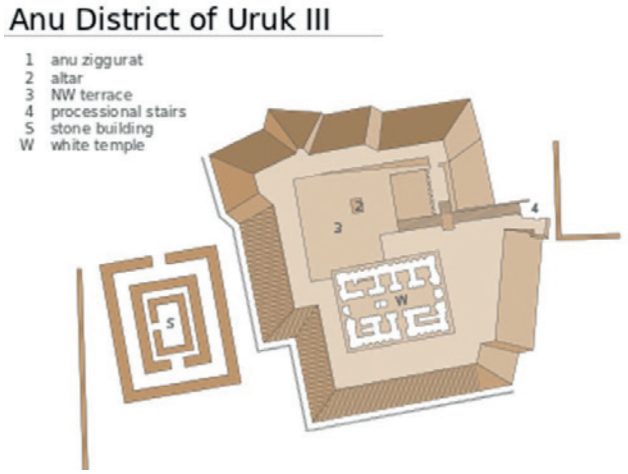


Figure 111. Anu District of Uruk III (3100–2900 BCE), Photo from Wikipedia

The structures of Anu District of Uruk III are different from the great bath at Mohenjo Daro, as shown in figure 112. The great bath of Mohenjo Daro was more complex than the structures in Anu District of Uruk III.

Figure 111 shows the internal structure of a temple from Uruk III and the internal structure of the great bath of Mohenjo Daro. Both structures show different planning: the great bath had a water pool inside, but at Anu District there was a white temple (both structures are shown in rectangles). However, the yellow rectangle in figure 112 shows similar structures located on the east side of the great bath at Mohenjo Daro and the north side of the temple at Anu District of Uruk III. The green structure in figure 112 shows that the western structures of the great bath of Mohenjo Daro had a granary structure and that Anu District of Uruk III had a complex stone building. The granary and stone building both have different plans.

Anu District had a ziggurat and stone buildings. The great bath of Mohenjo Daro was constructed with baked bricks and had a water structure/swimming pool inside. At Anu District, there is evidence of fire altars (shown in figure 111, point 2) but at Mohenjo Daro there is no evidence of fire worship.

The planning of the ziggurat at Anu District of Uruk III and the great bath at the Upper district of Mohenjo Daro exhibit some similar structures (as shown in figure 111) since both have a central part for religious purposes, followed by a row of similar structures. The inner part of the great bath complex is a water pool surrounded by complex structures; to the east of the pool there is a row of five square chambers. Similar rows of five square chambers to the east can be seen at the ziggurat of Anu District, as shown in Figure 112.

The representation of the inner structure devoted to major rituals, which is surrounded by similar structures of chambers, represents a similar urban pattern. But the evidence of different worship practices, such as fire altars at Anu districts and a water pool at the great bath, demonstrate that both societies had different religious ideologies.

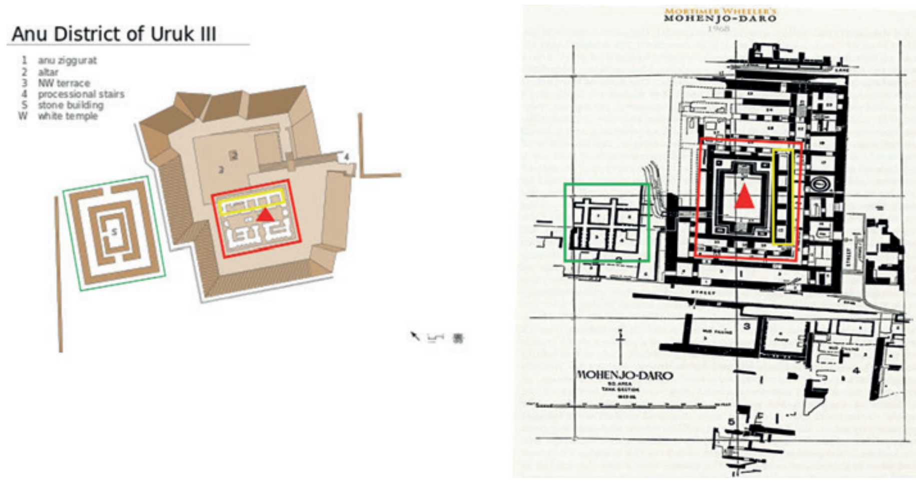


FIGURE 112. The red rectangles show the internal structure of a temple from Uruk III and the internal structure of the great bath of Mohenjo Daro.

There are unique type of structure that can be seen at the western side of both complexes, marked in the green square in figure 112. At the great bath of Mohenjo Daro, it is attributed as a granary or warehouse. There is no evidence of grains from granary structure and therefore it is also termed as great hall or warehouse with uncertain functions (Kenoyer, 1998; Possehl, 2002). Possehl suggested that warehouse might be used for stored things such as food, leather, wood, clothes etc. But there is not certain function known yet.

At Anu District of Uruk the western complex structure referred as a stone building and the function of the structure is also not clear. Both structures also represent similar urban planning. But the warehouse of Mohenjo Daro was constructed one storey below the great bath and repaired many times. The building walls and supports are made with wooden planks and timber (Possehl, 2002). However, at Anu district stone building is not connected to any major building and presents complex gateways to enter the central part of the building. The functions of both structures at Mohenjo Daro and at Anu district of Uruk are not clear.

8.6 Comparison of Mesopotamia and Indus urban development and settlement patterns

Based on the above analysis, it is clear that two macro-regions under discussion exhibit variability among settlement patterns, in terms of urban attributes and urban development processes.

At Mesopotamia, urban developments started earlier compared to Indus society. The archaeological evidence shows that urban developments at Mesopotamia during the 4th millennium BCE were more complex than those at the Indus society during the 4th millennium BCE. The first known walled urban center was a small settlement named Jericho that developed around 8000 BCE. From 8000 to 3000 BCE the Mesopotamian societies experienced complex socio-economic, political and cultural transitions. Around 3000 BCE, Mesopotamia emerged as a complex type of urban society. At Indus society, the first large village settlement, Mehrgarh, developed around 6000 BCE, followed by the emergence of quasi-urban sites around 3000 BCE, but a fully developed urban society emerged around 2600 BCE, with a more complex social infrastructure.

The internal settlement patterns of the respective societies exhibit different characteristics. The Mesopotamian settlements exhibit unplanned and irregular plans (Mieroop, 1999). However, most of the Indus settlements have two to three different plan levels known as Upper town, Middle town, and Lower town. The Mesopotamian settlements have well defined monument structures, such as temples and palaces, as discussed in 8.5.1, but the Indus settlements do not exhibit clear evidence of monument architecture; rather, they are different from the palace or temple type architecture discussed in Chapter 7. Some of the major variabilities are discussed below.

8.6.1 Geography landscape and water sources

The urban expansion of Indus society covered an area of about 1.2 million km^2; however, Mesopotamia occupied a land of about 65,000 km^2 (Cotterell, 2011). The geographical expansion of Indus society was more extended than that of Mesopotamia. The geographical expansion emphasises that it had a greater population than Mesopotamia. Although less is known about the socio-political system of the Indus society, it is clear that they had a more sophisticated socio-political system than Mesopotamia.

The major settlements from both societies were located around major rivers, although river avulsion at Indus society was a common problem that affected settlement patterns. The settlements from Indus society were discovered around the Indus River and Ghaggar-Hakra River systems. The settlements from Mesopotamia were discovered around the Tigris River and the Euphrates River systems. The river systems within the Indus society are more complex than those at Mesopotamia, such as there are 5 large rivers that entered into the river Indus and make it more complex and giant. Another well known river system of Indus society was the Ghaggar Hakra as discussed in 3.1. The largest city of Mesopotamia, Uruk, located on the bank of the river Euphrates. Mohenjo Daro was located on the bank of the Indus. The location of Uruk and Mohenjo Daro emphasise their socio-economic importance. The Indus society is geographically extensive and has a great variation of regional landscape and environmental conditions. For example, the present-day Cholistan region is a flat desert plain with extreme weather conditions and no water sources, as discussed in 3.2; however, it is believed that during the 3rd millennium BCE, the Ghaggar-Hakra River was a major source of water (as discussed in Chapter 4). At Mesopotamia, the Diyala is a gigantic river that remains active to this day, and there is no doubt of settlements from 3000 BCE.

The dry weather conditions, with less rain, allowed the Mesopotamian people to develop a canal system. The canal system was also beneficial for annual flooding problems. However, the Indus society people did not develop a canal system at Mohenjo Daro, Harappa, or Rakhigarhi. The Indus society received water from rain and rivers, but at Mesopotamia, there was less rain. The people of the Cholistan region did not develop any water management systems or artificial water storage facilities (as far we know). Only at the Dholavira settlement is there evidence of water tanks to collect rainwater along with some water channels. Although this practise was rare at other Indus settlements because the environmental conditions at other large urban centers were different from those at the Dholavira settlement.

The water management and canal system at Dholavira was common practice in Mesopotamia. However, at Mesopotamian settlements there is no evidence of water reservoirs. That indicates that Dholavira architects had a different approach to urban planning. The evidence of water tanks and water channels from Dholavira settlement state that the people of Indus society had the ability to find solutions to different climatic conditions.

8.6.2 Urban development and processes

Agrarian activities were the backbone for urban processes and development in respective societies. However, agriculture practices started much earlier in Mesopotamia than Indus Society, around 8000

BCE. Farming communities started to settle at that time. The earliest remains of Indus society urban practices started around 6000 BCE. Urban development and processes at Mesopotamia are much older than in Indus society. The Indus settlements do not show evidence of agricultural practices inside urban centers, which means they probably used hinterlands for the crop production. Mohenjo Daro was a planned city within Indus society. Archaeological evidence from the settlement has demonstrated that the city was much involved in craft production instead of agricultural activities. However, Mesopotamian cities were developed from the farming villages that became larger settlements. Indus society exhibits unique and planned settlements, such as Mohenjo Daro and Dholavira. But at Mesopotamia, there is no evidence of any planned settlement.

Another significant feature of Indus settlement is town division. Most of the settlements have two different elevations, generally known as Upper town and Lower town, but at Mesopotamia, no elevations within the settlements exist.

The results of the present research demonstrate that the urban development and processes at Mesopotamia were slower than those in the Indus society. The Indus society had advanced and much faster urban development. Complex urban attributes appear suddenly at Mohenjo Daro rather than at Uruk settlement.

8.6.3 Settlement patterns

The settlement pattern at Mesopotamia presents a nucleated type of settlement system that presents a hierarchical order. They had a high number of larger settlements that were controlled by a complex socio-political system. The largest settlement was surrounded by the smaller settlements, which were further surrounded by the villages or smallest settlements. The settlement system presents a flow of power and exchange.

However, the settlement pattern at Indus society seems to have had, according to available evidence, only five larger settlements as major social organizations. The larger settlements were limited in number, but they present an equidistant settlement pattern, as discussed in Chapter 7. Five major Indus urban centers were spaced at larger distances. Within the spaces of larger urban centers, there are smaller or scale D settlements. However, at Mesopotamia, there is no evidence of an equidistant pattern and settlements are found at closely spaced distances.

The internal settlement features also exhibit different attributes at Indus society and Mesopotamia regions. The settlement plans of Indus settlements present greater similarities in fundamental urban attributes such as division of settlements, construction material, and architectural details. The Harappa, Ganweriwala, and Rakhigarhi settlements were developed from small villages and exhibit an unplanned settlement nature similar to Uruk settlement of Mesopotamia. For example, the internal settlement features at Harappa suggests that it was unplanned. Most of the buildings were added during the urban period around 2500 BCE. Mesopotamian settlements exhibit variabilities in settlement plan and architectural details.

One of the significant features of respective regions is fortification of the settlement. Almost every settlement from the Mesopotamia region was fortified with walls surrounded by the settlement. Such as all settlements around the Diyala plains were fortified. Even the smaller settlements, such as villages, had fortification walls. However, the feature of fortification is unique at the Indus settlements. There is no record of fortification walls around smaller settlements, and even some larger settlements have a different type of fortification. Most of the settlements had elevated platforms to protect the settlement from flood water. For example, Mohenjo Daro had a high elevation instead of fortification walls around the settlement (details in Chapter 3). Only the Upper Town of Mohenjo Daro exhibits few traces of a fortification wall that is considered to have been used for defensive purposes, but the remains of the wall are not clear. However, the Harappa settlement presents the remains of a fortification wall around the settlement. But other settlements like Ganweriwala and Rakhigarhi do not evidence fortification walls around the settlements.

The variability of fortification systems at both regions suggest that social security was a much concerned matter at Mesopotamia. At the Indus society, the social stability and the functions of organization were different and more highly complex than Mesopotamian settlements.

Another significant feature of Indus settlement is the practice of hygiene and the sanitation system as a part of urban planning. Making wells in houses for freshwater, covering street lanes, and separating areas for toilet use are examples. The practice of hygiene and sanitation is missing at Mesopotamia.

The largest settlements from Indus society present some unique structures, such as the great bath at Mohenjo Daro, the circular platforms at Harappa, and the water reservoirs at Dholavira. These structures are uniquely associated with the specific settlements.

However, at Mesopotamia, most of the settlements structures are associated with religious practices or palaces. Indus settlements do not evidence power dominance or religious authorities; however, the larger urban Indus centers present different regional scales that mutually worked together to constitute the urban infrastructure of society.

Features	Indus society	Mesopotamia
Regional settlement pattern	5 tiered Hierarchy	3 tiered Hierarchy
Large settlements	5 (known)	There are many large settlements. Exact numbers are unknown.
Settlement Plan	Semi Planned	Irregular or unplanned
Fortifications	Mostly higher platforms from ground level; there is no complete evidence of fortification walls. Only Harappa has traces of a fortification wall and Dholavira has a fortification wall.	Present(All settlements had fortification walls)
Palaces	Only Dholavira had palace	Present (All large settlements had palaces)
Temples	Not found	Present
Sanitation and Hygiene	Present (Covered drains, toilets, wells)	Not found
Construction material	Baked bricks with a specific ratio of 1:2:4 or stones	Sun-dried bricks

Table 32. Mesopotamia and the Indus society major variables

The socio-political system of the Indus society is not yet clear. The Indus society might follow bureaucratic rules using the mutual interaction of different authorities. If it was controlled as a centralised authority, it presents a more sophisticated socio-political system than the one in Mesopotamia. But the hypothesis needs more research.

8.6.4 Construction material

Mesopotamian architects used sun-dried bricks of various sizes and shapes. This construction material for the Mesopotamian settlements presents a large problem for understanding urban processes because sun-dried bricks are perishable. Sun-dried bricks are not resistant to flood and rain water. As such, the structures were easily demolished and, therefore, had to be constructed over and over again. However, there is no evidence of baked bricks being used in Mesopotamian settlements. The architects of the Indus society used baked bricks with a standardised ratio of 1:2:4. All settlements followed similar brick ratios. The standardisation of construction materials demonstrates that brick production was controlled. But at Mesopotamia, there is no evidence of the standardized baked-bricks type of construction material.

CHAPTER 9

Conclusions and outlook

The main objectives of the present thesis are:

- the nature and urban scale of Ganweriwala settlement, with the physical survey of its environment and analysis of artefacts
- the regional scales of five large urban centers in relation to each other that constitute the urban infrastructure of the Indus society from 2600 to 1900 BCE
- Major similarities and differences of urban development between the Indus society and Mesopotamia

The following sections revisit each of the objectives and discusses each individually to draw conclusions from the thesis. The Indus society's larger settlements from present-day Pakistan have been interpreted as highly similar social organisations; however, this notion is generally based on the research of a limited number of settlements. The most frequently excavated settlements are Mohenjo Daro and Harappa, and several other significant settlements are little studied or still unexplored. My discussion started at the nature of Ganweriwala settlement and its environment, which has been rarely analysed before this present research. Further, four large urban settlements are analysed to trace similarities and differences kown as Mohenjo Daro, Harappa, Dholavira and Rakhigarhi. In addition, there is a comprehensive discussion on similarities and differences between the Indus and Mesopotamian urban development.

This present study suggests that the comparison of physical attributes of individual settlements, particularly lesser known settlements and unexplored regions, can be more beneficial than immediately trying to apply different socio-political models on available data. The present study stresses the importance of generating new data sets by including several larger settlements for a comprehensive analysis of the Indus society. This approach can be beneficial to address several aspects of the society that cannot be addressed by socio-political models such as socio-culture and socio-economy of different regions.

The major focus of the work is on the scale of Ganweriwala settlement with the aim of new explorations, and an artefact analysis to understand the complexity of Indus urban infrastructure. My work has analysed the topography of the settlement and concluded that it covers an area of approximately 67 ha. The artefacts and surface analysis show that the settlement shared socio-cultural practices with the other large urban centers. Present research is the first attempt that analysed artefacts from Ganweriwala. Ganweriwala settlement has been the subject of superficial discussion before the present study, and there is no research available that discusses its scale. I have proposed that the five known urban centers of the Indus society were developed through complex socio-economic, cultural and environmental processes; all urban centers were functionally active during the urban period and have different regional scales, as discussed in chapter 7. Ganweriwala settlement is one of the relatively unknown ones that can open new chapters in existing knowledge about the Indus society. The primary features of large Indus urban centers seem to be similar; however, some variabilities exist in secondary features. The present analysis of settlements shows there is more variability than similarities. Moreover, there is no direct evidence of centralised authority, which emphasises that it was a highly complex society during the urban period 2600–1900 BCE.

9.1 Indus urbanism

The Indus urban period is associated with a rise in settlement number around 2500 BCE. Limited evidence available indicates that the number of settlements increased from 486 to 1,050. The settlement number doubled within the duration of a few centuries. The sizes of small settlements also increased. The following graph shows the increased number of settlements.

Increase in Settlements

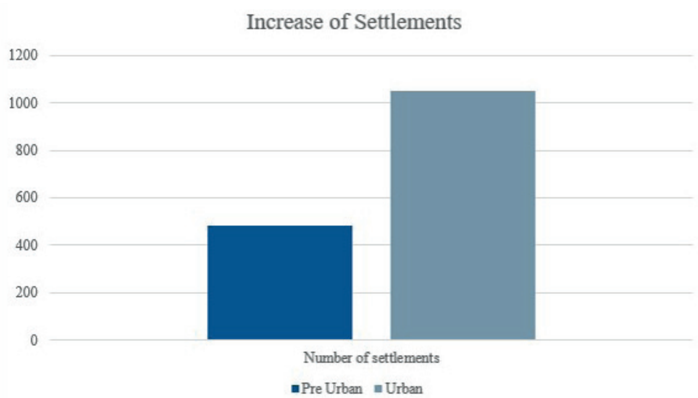


Figure 113. Number of settlements from pre-urban to urban from the Indus region

However, the settlement number started to decrease around 1900 BCE, and a settlement shift happened towards the northwest of India. During the urban period, the Cholistan region had the highest density of urban development. But the present-day environment in this region does not support human existence. The highest number of urban period settlements and the environment of the region make it a crucial region to investigate in terms of the paleoenvironment.

It is generally accepted that the Indus settlements shifted towards the northwest of India during the post-urban period (1900–1300 BCE). The settlement change is associated with changes of subsistence practices affected by a change in monsoon rain and a shift of river courses (Petrie et al., 2017).

9.1.1 Urban development of the Cholistan region and environment

The Cholistan region exhibits the largest settlement density (as to archaeologically known sites) and a unique environment. The geographical location, site size, and environment of Ganweriwala has invited discussion about the socio-economic and cultural characteristics of Ganweriwala site. However, the site has become the victim of superficial discussion about its size. Systematic study and a fresh perspective on that region can be beneficial for the understanding of the social structure of the Indus society. The questions of complex processes, for example, site formation, architecture, and settlement plan, cannot be answered until excavation begins, but the topographical and cultural material study is useful for a preliminary study of the variabilities between excavated/unexcavated sites (for details, see Chapter 7). Thus, the data regarding Ganweriwala case opens up new discussions about the Indus urban development and processes.

Ganweriwala site is well preserved because it is protected by sand dunes of the desert environment. One example of that type of archaeological case is well documented at northern Mesopotamia, known as Tell Brak (Emberling, et al., 1999). Before the excavation of Tell Brak, southern Mesopotamia was suggested to be the major region for urban development. But excavations at Tell Brak withdrew long held concepts, and now it is accepted that the urbanisation in northern Mesopotamia started earlier than in southern Mesopotamia (Wilkinson, 2007). Further studies on sub-urban regions of Tell Brak suggest that the origin of urbanism was even more complex than present understanding (Ur et al., 2011).

9.1.2 The socio-economic, the cultural and the urban scale of Ganweriwala settlement

I have analysed the most problematic issues regarding Ganweriwala settlement size. Different authors provided different sizes of the settlement, and there are three different sizes reported as 81.7 ha, 64 ha, 42 ha, as mentioned earlier (Mughal, 1997; Manuel, 2008; Masih, 2018). Initially it was reported as 81.7 ha in size; however, later it was reported as a 42 ha settlement, which is almost half of Mughal's reported size (Mughal, 1997; Masih, 2018). These reports present a difference of about 39 ha, and the two different measurements created a problem regarding the scale of Ganweriwala settlement. Although the reports were based on traditional measuring methods, they lack accuracy. In 2008, Manuel reported in his doctoral thesis that Ganweriwala is a 64 ha settlement, but his statement does not clarify how he measured the site (Manuel, 2008).

The present thesis presented a contour map of Ganweriwala showing it to be 66.7 ha in size using more advanced measurement methods (Gulzar, 2020). The estimated settlement size concluded in this study is only 15 ha less than the one reported by Mughal and only 3.7 ha greater than the one reported by Manuel in his PhD thesis in 2008.

The present study is the first to report an accurate contour map with an estimation of an average settlement size. Ganweriwala was a large urban center during the Indus urban period, developed by regional urban processes. It was the largest settlement of the Cholistan region during the urban period, which developed in the network of several smaller settlements. The local scale of Ganweriwala is similar to other urban centers; however, the regional scale is different from the Mohenjo Daro.

The examination of the surface collection concluded that Ganweriwala shared a cultural ideology with other large urban centers: the settlement plan, special production, household items, and writing are similar. The collection has been divided into four different types:

- Bricks
- Mnemotechnic artefacts
- Adornment and toys
- Utility artefacts

All these types represent similar socio-cultural attributes that belong to the urban period, standardisation, and designs. Bricks from Ganweriwala present the ratio of 1:2:4, which is a standard urban period brick size. A SEM-EDX analysis of artefacts from Mohenjo Daro, Harappa, and Ganweriwala does not show any major differences in production techniques, although the different mineral composition of raw clay suggests that they were locally produced.

The analysis of Ganweriwala settlement indicates that the region had a different environment in the past compared to the present-day environment. The study of the urban development of the region concludes that the regional environment around the 3rd millennium BCE was suitable for urban development.

9.2 Indus urban infrastructure and scales of the Indus settlements

My work has opened a new line of discussion about Indus urban infrastructure. Indus society has been discussed as socio-political models or organisations, but no study suggested looking at different attributes and scales of the settlements and looking closer at the urban infrastructure. This new perspective allows for a better understanding of the Indus settlement's complexity. These large urban centers varied in size, ranging from 60 to 300 ha. The smaller settlements varied from 1 to 20 ha in size. However, there is no evidence of any settlement ranging between 20 to 60 ha. The larger settlements are located at almost equal distances and are surrounded by the vast hinterland. The approximate distance between Mohenjo Daro and Ganweriwala is around 280 km, and Ganweriwala to Harappa is around 260 km. These large urban centers are surrounded by several hundreds of smaller settlements or villages. The urban landscape looks like there is a sea of villages, and there are closely packed urban centers (Adams, 2018).

The distance between urban centers presents unusual data compared to any other city-state societies, such as early historic south Asia, Dynastic Mesopotamia, and Mesoamerica (Sinopli, 2015). These societies have cities in closely packed distances, usually tens of kilometres or a few day's travel time on foot.

The topographic and artefact analyses from Ganweriwala have confirmed that it had inter-regional trade and exchange with Mohenjo Daro and other, larger urban centers. The material culture of the Indus society is evidence of (minor) regional variabilities, and the research on regional variabilities is advancing (Ameri, 2013). Primary components are similar; only secondary components present variabilities.

This study also suggests that the structural, functional, and urban attributes of five major urban centers are different and have different urban scales as discussed in chapter 7. Mohenjo Daro is the largest settlement with unique urban attributes that are missing from any other settlements such as the Indus society and Mesopotamia. According to the archaeological evidence and state of research, Mohenjo Daro and Dholavira were planned settlements. However, both have different character and urban scale.

9.3 Similarities and Variabilities of urban development and process between Mesopotamia and the Indus Society

The urbanism of Mesopotamia developed contemporaneously with the Indus society but exhibits different processes and shows fewer similarities and several variabilities. A major factor of variabilities is that the local environment impacted the socio-cultural systems and settlement patterns. For example, the rain patterns and rivers of the Indus region are more complex than those in the Mesopotamia region.

Indus urban centers were denser and more advanced than Mesopotamian urban centers in terms of hygiene and sanitation. Indus urbanism also presents a geographically larger region than Mesopotamia. Mesopotamian urban centers present a socio-political hierarchy; however, Indus urban centers present less hierarchical divisions compared to Mesopotamian urban centers.

Research outlook

I am looking forward to the excavations at Ganweriwala settlement that will contribute significantly to understanding Indus social and urban complexity. The site is a reasonably well preserved one and therefore has the potential to bring out new evidence that can provoke new discussion on Indus urbanism. All other urban centers were excavated by old methods and, because of several problems, the data is problematic for comparative studies. However, Ganweriwala settlement is very promising for future investigations and has the potential for breakthrough results.

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Appendix

Description of all objects is mentioned in table 3 in the text.

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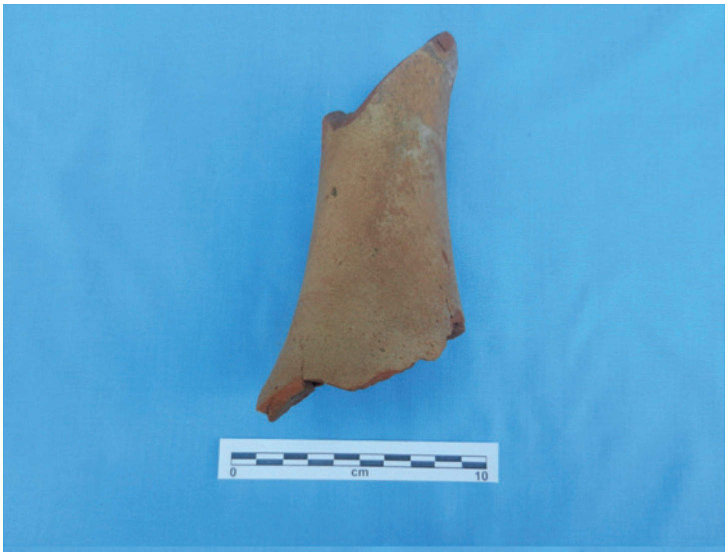

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Svensk sammanfattning

Målet med avhandlingen är att analysera de viktigaste skillnaderna inom Indussamhällets bosättningar och urbana infrastruktur under perioden 2600-1900 f.Kr. Det inkluderar en undersökning av urbaniseringsprocessen i förhållande till populationens storlek, bosättningsareal och de urbana centrens geografiska placering. Urbaniseringens påverkan på den regionala miljön behandlas också. Målsättningen för avhandlingen är att analysera Indussamhällets urbana infrastruktur genom att jämföra arkeologisk data från de största stadsformationerna. Utöver detta har den urbana processen och utvecklingen från Indusregionen jämförts med den Mesopotamiska regionen på flera plan.

På den första nivån används en jämförande metod och urban skal-teori för att undersöka likheter och olikheter inom de största urbana bosättningarna i Indusregionen under perioden (2600-1900 f.Kr.). Tillgängligt arkeologiskt material med fokus på ett begränsat antal artefakter från Mohenjo Daro, Harappa och Ganweriwala är analyserade och jämförda med metoden SEM-EDX. Resultaten från SEM-EDX analysen visar att artefakterna var producerade lokalt. Ganweriwala fick extra fokus eftersom det är den hittills minst undersökta bosättningen i Indusregionen. Det största problemet i förståelsen för utvecklingen av den urbana infrastrukturen inom Indussamhället är kunskapsgapet kring Ganweriwalas bosättning. Denna brist tas upp i föreliggande arbete. Ganweriwalabosättningens urbana skala analyserades genom en attributbaserad metod. Resultatet från yt- och artefaktstudien från Ganweriwala indikerar att platsen varit ett större urbant centrum under Indus stadsperiod 2600-1900 f.Kr.. Platsen delar liknande kulturella uttryck med andra stora urbana centrum såsom stadsplan, typer av artefakter, skrift på lertavlor och vissa typer av figuriner. Jag menar, genom att använda data från Ganweriwala som en fallstudie, att Indus urbana infrastruktur är ett komplext fenomen med större likheter och färre skillnader. Fem större urbana centra fanns på olika urbana- och socioekonomiska skalor. Denna studie bidrar med en djupare teoretisk och empirisk förståelse kring Ganweriwalas bosättning i relation till dess kringliggande miljö, vilken aldrig tidigare undersökts eller rapporterats.

På en andra nivå jämförs bosättningar i Diyalaregionen i Mesopotamien med Cholistanregionen i Indussamhället för att spåra likheter och skillnader i den urbana processen och dess påverkan på miljön. Den största bosättningen i Mesopotamien är känd som Uruk, den jämförs med den största bosättningen från Indusregionen kallad Mohenjo Daro. Slutsatsen som nåddes genom jämförelsen mellan bosättningarnas data från Diyalaregionen och Cholistanregionen visar på att bosättningarna i Cholistan var mer tätbebyggda än i Diyalaregionen. De urbana bosättningarna i Cholistan var totalt övergivna runt 1900 f.Kr.. I Diyalaregionen fanns fortfarande en kontinuitet i bosättningen vid 1900-talet f.Kr.

Mesopotamien och Indussamhället var båda (6000-1900 f.Kr.) urbana samhällen med stora, tätbefolkade och planerade städer – där tidigare forskning varit svag på urbana processer och miljöstudier. Dessa forntida kulturers urbana processer från specifika regioner jämförs på flera plan. Resultatet i det föreliggande arbetet åskådliggör att det forntida Indussamhället visar på komplexa mönster av urbanitet som var sällsynta i andra antika samhällen. Indussamhället hade en större expansion än Mesopotamien, men hade samtidigt ett begränsat antal större urbana centrum. De stora urbana bosättningarna från båda dessa samhällen visade på variabilitet – skilda typer av stadsplaner, städerna var konstruerade med olika byggnadsmaterial och den omgivande miljön/naturen skilde sig åt. En annan slutsats är att urbaniseringens utveckling och process i respektive makroregion tog sig olika uttryck.