Site Catchment Analysis of the Sorath Harappan Settlement at Jaidak (Pithad), Jamnagar District, Gujarat

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Received: 18 July 2021; Revised: 27 September 2021; Accepted: 09 November 2021
Heritage: Journal of Multidisciplinary Studies in Archaeology 9 (2021-22): 80-108

Abstract: *An area covering 20km radius around the Sorath Harappan sites at Jaidak (Pithad) in Jamnagar district of Gujarat was surveyed for site catchment studies with a view of understanding the nature of cultural development at the site*[1]*. Of the fifteen sites of different periods reported in the survey, ten were occupied by the Harappans. The rest were historic period sites. Most of the Harappan sites show multiple-phase occupations beginning with the Rangpur IIB period followed by the Rangpur IIC. A few indicate occupation only during the Rangpur IIC period. the present study not only revealed the location and nature of subsistence resources but also of the raw material resources for craft activities at Jaidak. It suggests that the numerous small settlements in the surveyed area, in all probability supported the growth of larger settlement at Jaidak by being a part of the subsistence and economic production network. This interactive mechanism of symbiotic exchange probably was the medium through which goods, people.*

Keywords: Jaidak, Classical Harappan, Sorath Harappan, Rangpur, Site Catchment Analysis, Pottery, Copper

Introduction

The site at Jaidak (23° 39.5'N; 70° 34.43'E) (Figure 1) is located about 4.5km southeast of the Pithad village on the right bank of the river Aji in the Jodiya taluka of the Jamnagar district. The site was first reported by P. P. Pandya of the Archaeological Unit of the Government of Bombay at Rajkot, while exploring the Jamnagar and Rajkot districts (IAR 1959-60). He had reported from Pithad pieces of Harappan pottery, particularly two dishes-on-stand. In 1963, S.R. Rao (Rao 1963) classified it into the "Late Harappan" phase affiliated to the Rangpur Period IIC of his newly proposed four-fold sequence of the Harappan cultural development in Gujarat. In the early 1980's, K. K. Bhan of the M.S. University of Baroda too categorized the artifact assemblage from the site to the Rangpur IIC (IAR 1979-80, Bhan 1983) as a part of his Doctoral dissertation on the archaeology of Jamnagar district. Subsequent to this, in 1992 the Department of

Archaeology and Ancient History, The M. S. University of Baroda carried out a small-scale excavation at the south-eastern extension of the site (Jaidak-II); unearthing over 1.00m thick chalcolithic habitation deposit including the remains of several stone structures (IAR 1991-92, Ajithprasad 2008, 2003). The site was excavated recently by the Department of Archaeology and Ancient History, The Maharaja Sayajirao University of Baroda for consecutively two field seasons – 2005-'06 and 2006-'07 (UGC-SAP Report 2007).

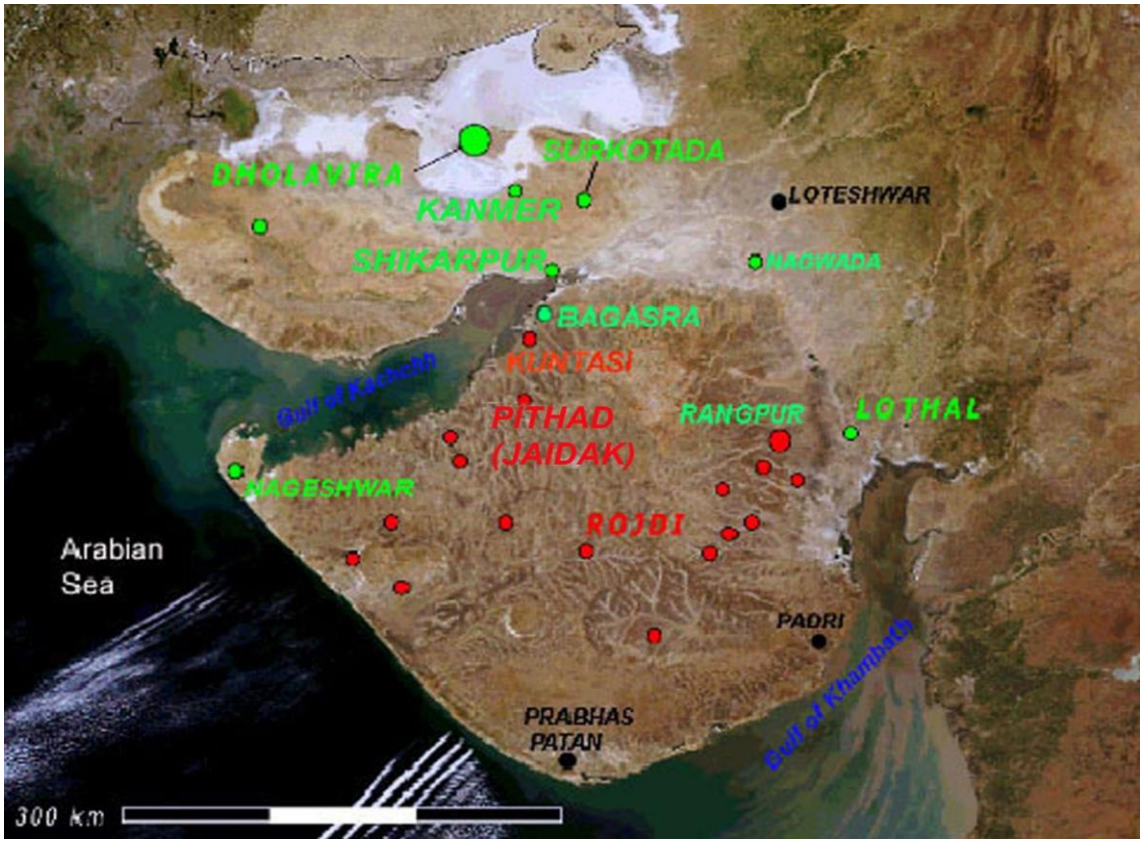

Figure 1: Jaidak (Pithad) and other Major Harappan sites of Gujarat

Jaidak (Figure 2) measuring 15ht, is one of the largest Sorath Harappan settlements in Saurashtra in terms of its size and spread. The noteworthy features of Sorath Harappan (see Possehl *et al.* 1984 and 1985; Posshel and Raval 1989, Posshel and Herman 1991) that have been identified from study of the remains at Jaidak on a comparative basis with other Harappan sites in Saurashtra, include, the distinctiveness of its architecture (Figure 3), a mixed economy based on pastoralism and agriculture dominated by the cultivation of millets, and also participation in an internal exchange network with the Classical Harappan sites. Besides, other aspects of the general lifestyle of the people have been discerned from the nature of artifact and pottery assemblage. Another aspect that was taken up in the present study is the catchment analysis of Jaidak within a radius of 20km. This survey has significantly contributed to an understanding of the nature of the Sorath Harappan settlement at Jaidak and its interactive zones spread across the northern and central parts of Saurashtra.

Figure 2: A View Jaidak site and Aji River (Courtesy: MSU, Vadodara)

The area of study forms a part of the region of Saurashtra lying between the 400mm to 800mm isohyets. The area mainly falls within the jurisdiction of two adjoining districts of Rajkot and Jamnagar. The focal point of the study, however centers on the site of Jaidak (Pithad) in the Jodiya Taluka of the Jamnagar district and is located on the right bank of the Aji river, which flows into the Gulf of Kachchh. The area has been demarcated in a radius of 20km. Parts of five talukas of the Jamnagar and Rajkot districts fall within the survey region – Jodiya, Dhrol, Paddhari, Morbi and Tankara. The site is about 4.5km southeast of the village of Pithad, on the right bank of the river Aji. The area lies mainly in the northern parts of the Saurashtra peninsula, and also extends into the central Saurashtra. The northern parts of Saurashtra are covered by a thick cover of alluvium, while the central portion lies on the basaltic Deccan Trap formation. The major portion of the survey area is fertile, drained by the Aji and the Demi systems. The southern parts, on the other hand, represent a rather undulating landscape with scattered vegetation and cropping.

The Site and its Cultural and Chronological Framework

In this study, a simple bipartite system of chronology has been followed: The Mature/Urban Phase Harappan between c. 2600-1900 B. C. in full swing in the Harappan sites in Sindh and Baluchistan which may be divided into the initial and late phases. While in Gujarat, especially in Saurashtra, the Mature/Urban Harappan Phase is represented by the Sorath Harappan (Rangpur IIA-IIB). The Post-Urban Harappan phase between 1900-1700 B.C. is represented by the Late Sorath Harappan (Rangpur IIC-III) (Table 1). The focal point of the study is the excavated Harappan site of Jaidak

(Pithad) which has a well-defined stratigraphic sequence predominantly belonging to the Sorath Harappan preceded by the Mesolithic/microlithic. Details of the two cultural periods and the subdivision thereof are described below (Sen 2009):

Table 1: Comparative Chronological Chart of Excavated Sites used in the Present Study (Sen 2009)

Cultural Phases		**Comparable Phases of Other Excavated sites in Saurashtra**
Period I - Mesolithic		Rangpur I
Period II – Sorath Harappan	Period IIA – Early Phase (c. 2200/2100-1900 B. C.)*	Rangpur IIA(?), IIB Rojdi B Kuntasi IA & IB Bagasra Phase III Lothal B Surkotada IB & IC
	Period IIB – Late Phase (c. 1900-1700 B. C.)*	Rangpur IIC Rojdi C Kuntasi II (?) Bagasra Phase IV

*Beta Analytic Radio Carbon Dating Laboratory, Florida

Period I – The Mesolithic habitation at the site is confined to the southeast periphery of the site. The Mesolithic remains excavated had 1m thick deposit resting directly over disintegrated bedrock (IAR 1992). The finds belonging to this period incorporated bits and pieces of charcoal and very few microliths (Figure 3). These are found associated with two working levels separated by a rather sterile silty-sand deposit indicating that the mudflat was active during the Mesolithic times.

Period II – The maximum habitation deposit at the site is 2.30m that belonged to two distinct phases of Harappan occupation.

***Period IIA* –** The early phase has an overall deposit varying from 80cm to 2.30m in different trenches. This phase is marked by the construction of several rubble stone structures and a massive fortification wall surrounding the settlement (Figure 3). The beginning of this phase is in fact represented by the earliest deposit incorporating a few shallow pit-hearths and thin strips of ashy deposit in association with Sorath Harappan pottery and other remains. Two post-holes found associated with these remains in one of the deep trenches probably indicate some flimsy structures built around them in the early stages of habitation.

This is followed by the basic planning and layout of the settlement and the construction of the 2.75m thick fortification wall as well as a number of stone structures within and outside the fortified area. This phase is also marked by vigorous craft activities like copper and pottery production. Several kilns and crucible like containers

associated with these activities were found in successive layers. Most of the carnelian, steatite, amazonite, shell and faience beads from the site belonged to this phase. Besides, the assemblage shows close similarity with the pottery reported from the nearby sites in Saurashtra, particularly from Rangpur IIA (?) and IIB (Rao 1963), Rojdi B (Posshel and Raval 1989), Kuntasi IA and IB (Dhavalikar et. al 1996) and Bagasra Phase III (Sonawane et. al 2004) (Table 1). The final stage of this phase is associated with a structural collapse followed by a reconstruction period. The structures that of this stage and the habitation deposit associated with them are generally intermixed with ash and waste unlike the relatively clean habitation areas in the preceding layers. Some large pits were also dug up in the habitation area during this phase.

Period IIB – This phase shows a declining status of the economy with no major input in structural activities. The few new structures built on the remains of the previous phase are poor in quality and workmanship (Figure 3). This phase is marked by an absence of ornamental beads of semi-precious stones and faience. The entire Period IIB deposit is also mixed with ash and waste, and also associated with a number of large pits dug through the earlier deposit. The pottery assemblage is found similar to the late Sorath Harappan as represented by those from Rangpur IIC, Rojdi C and Bagasra Phase IV (Table 1).

Jaidak is one of the largest Sorath Harappan settlements in Saurashtra in terms of its size and spread. It exhibits the Classical Harappan standard bipartite plan with a citadel and a lower town and is roughly rectangular in shape (Figure 4). Other Sorath Harappan sites however do not demonstrate similar plan and layout. This feature makes Jaidak significant and indicates perhaps a closer interaction with the Classical Harappans. However, other features of the architectural constructions at many of the Sorath Harappan settlements are analogous. The material used for construction is preferably stone. This fact may be understood in the background that stone was abundantly available from the Deccan trap dykes exposed in many regions, specially the river beds in Saurashtra. Thus, the cost of quarrying and transportation of the raw material to the sites was minimal. But the fact that the Sorath Harappans were lacking the engineering skills of the Classical Harappans becomes apparent from the style of building. The stones were not hewn to give a defined shape, instead were used as amorphous blocks in the construction. The Classical Harappans on the other hand, preferred mud bricks of standardized ratio for their construction. In the later phases, although stone came to be used at these sites, they were carefully dressed into slabs and hence the finish and perfection of construction was maintained.

The Sorath Harappan sites are surrounded by perimeter walls about 3m thick. The fortification walls at the Classical Harappan sites on the other hand are massive in thickness. The thicknesses of the walls of the structures inside the fortification however do not show any difference at both categories of the Harappan sites. The difference was perhaps due to the purpose for which the fortification wall was constructed. The Classical Harappan settlements in Kachchh had been the 'administrative-trade-cum-

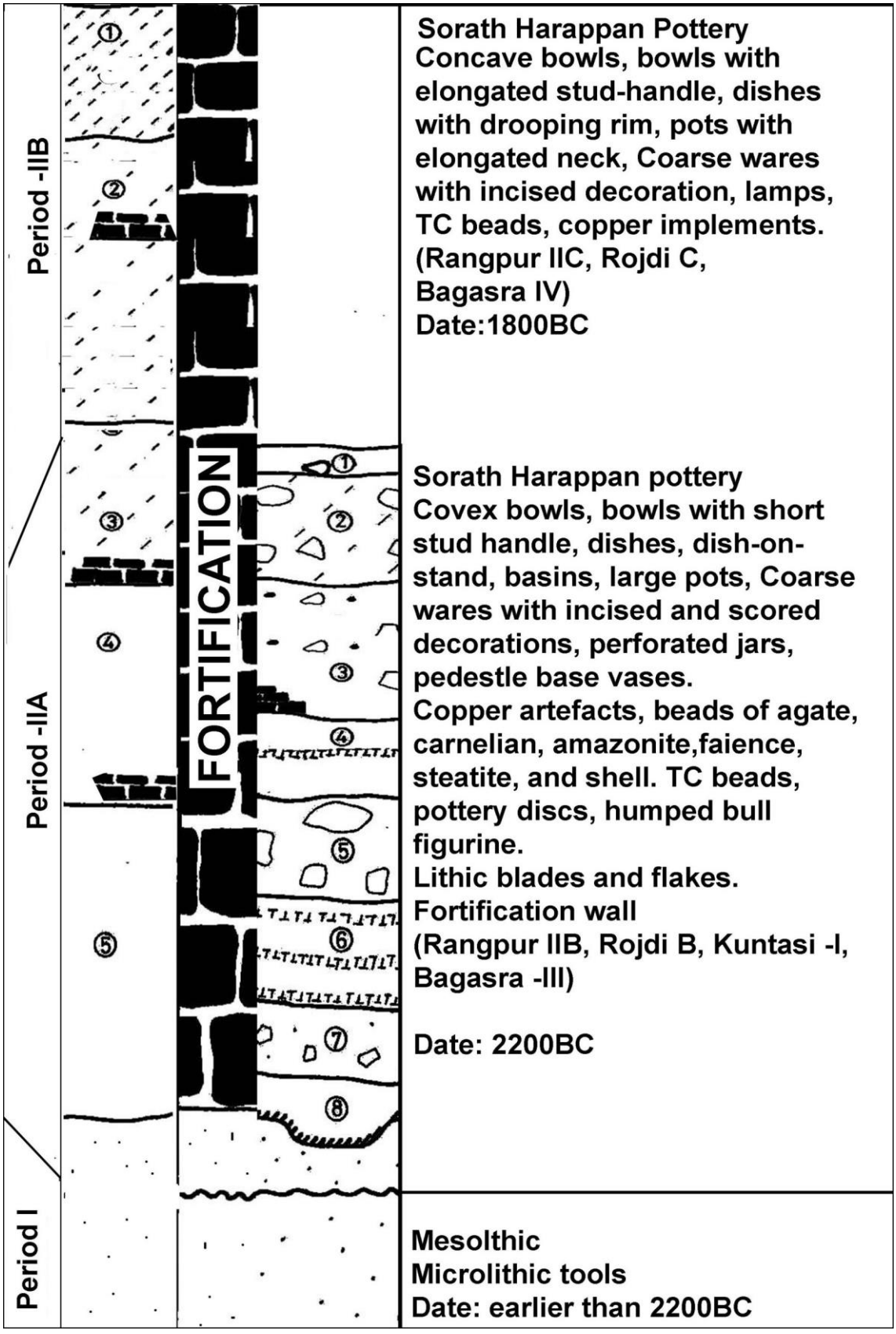

Figure 3: Schematic Cultural Sequence at Jaidak (Pithad)

political outposts' which provided a 'corridor' to Saurashtra (Soundrarajan 1984) and hence were strongly fortified for the reason of the fear of external invasion. The Sorath Harappan settlements were mostly residential settlements and their location on the banks or meanders of rivers provided natural protection in case of external attack, which however was not feared. In addition to this the fortification wall provided protection against trespassing of both humans and animals as well as from flood in the adjoining rivers.

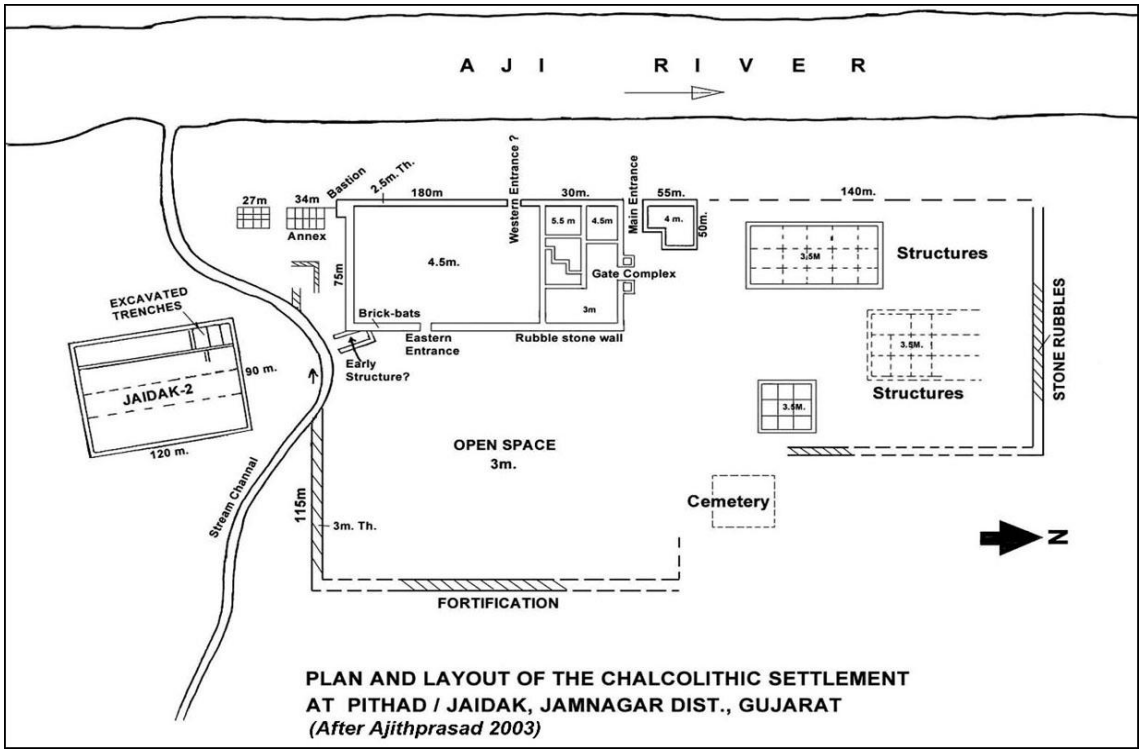

Figure 4: Plan and Layout of the Sorath Harappan Settlement at Jaidak (Pithad)

The presence of polygonal and/or curvilinear structures is yet another interesting and unique feature of architecture at the Sorath Harappan sites. Such structures are not noticed at the Classical Harappan sites in the Mature Phase but appear in the late phase. These have been interpreted as structural adaptation for keeping household herds as at Rojdi (Possehl and Raval 1989) which was of significance to the Sorath Harappans since herding formed a part of their economy. At Kuntasi the structure has been described as a shrine complex. At the Classical Harappan sites, instead the preference to monumental constructions like the granary, the great bath, etc. may be observed. The lacuna in the engineering skills of the Sorath Harappans may be further noticed in plan and layout of structures inside the fortification. The houses or streets were not laid following the grid plan as observed at the Classical Harappan sites. Instead they appear to have been constructed in clusters although an open courtyard perhaps for social congregations is found at Kuntasi and Jaidak. Structures related to storage and regulating the water supply, such as wells, tanks, etc. are absent at Sorath Harappan sites, while the water management system was given immense importance

at the Classical Harappan sites. The cultivation of the draught resistant millets by the Sorath Harappans together with the nearness of the sites to the perennial and semi-perennial rivers and streams did not give rise to the need to construct tanks or wells for storage of water. Whereas the Classical Harappan sites in Gujarat are mostly located in Kachchh, where there is perpetual scarcity of water, facilities for its storage were important to be maintained.

Another area that draws attention is the difference in subsistence activities of the Classical Harappans and the Sorath Harappans. Most of the Harappan sites depended on farming and stock-raising that included pastoralism, although economic production of craft items was also carried out actively at some of the larger sites. Agricultural practices of the Sorath Harappans, however involved the cultivation of *kharif* or summer crops, i.e. mainly millets, which were most suitable for the semi-arid and therefore uncertain climatic conditions of Saurashtra. Moreover, these crops were less labour-intensive and provided excellent fodder for the herds. Contrastingly, the Classical Harappans particularly in the 'core' region of the Civilization in Sindh and Punjab, were engaged in the cultivation of *rabi* or winter crops like wheat and barley which were monsoon dependent and required more tending.

Settlements and Site Catchment Approach

The culture area concept (Kroeber 1939), the concept of horizon (Willey and Philips 1958), and the notion of a settlement pattern (Willey 1953) are but three ways in which archaeologists have ordered space. Locational analysis in archaeology gained substantial importance in the 1970s and diversities in approach was introduced with the studies undertaken by Hodder and Orton (Hodder and Orton 1976; Hodder 1977). Thus two sets of approaches were established in the literature. The first highlights upon the importance of man-man relationship in structuring a community's ordering of space. In the second group emphasis has been laid upon man-land relationships in determining site locations (Roper 1979). Site catchment analysis belongs to the latter group. In this analysis considerations such as the availability, abundance, spacing and seasonality of plant, animal and mineral resources within a demarcated area surrounding a site gain primacy over the factors determining the site location. Thus the characteristics of the entire area, and not just the immediate locus of the site, are considered in inferring locational processes (Roper 1979).

The term site catchment analysis was first used by Vita-Finzi and Higgs (1970) in the study of Upper Palaeolithic and Neolithic sites in Palestine. Site catchment analysis has been defined by Vita-Finzi and Higgs (1970) as "the study of the relationship between technology and those natural resources lying within economic range of individual sites". The term catchment is traditionally used in the literature of geomorphology. It refers to the drainage basin or watershed and denotes the area from which a stream draws its water. In a similar fashion, the catchment of an archaeological site may be explained as the area from which the inhabitants of the site derive their resources. Vita-Finzi and Higgs (1970) have used the term "exploitation territory" instead of the

catchment area. They have defined it as "the territory surrounding the site which is exploited habitually". This "exploitation territory" or catchment area lies within a reasonable walking distance from the site.

Land use or exploitation of resources around the settlement is directly related to distance from the site/settlement. The walking distance has been assumed to be of 5km in the case of agricultural societies based on ethnographic works (Higgs 1975). On the other hand Vita-Finzi and Higgs (1970) have also used 2-hour walks from a site for hunter gatherers, and 1-hour walks for agriculturists. It has been observed that the farther one moves from an inhabited locus, the greater amount of energy must be expended for procurement of resources. Therefore it is assumed that the intensity of exploitation of the surrounding territory decreases, as one move away from the locus, eventually reaching a point beyond which exploitation is unprofitable. 'Human populations are generally only able to exploit resources that exist beyond a certain distance of their occupation site, be it a camp, cave, village or town' (Jarman 1972). "The further the area is from the site, the less it is likely to be exploited" (Vita-Finzi and Higgs 1970). Thus, the main area exploited for food another resources will be close to the site being considered. Site catchment analysis is based on the hypothesis that at different times or places the biophysical environment is exploited at different levels. This works provided that there is a finite distance the inhabitants of the settlement are willing to travel to exploit their environment. Therefore a basic premise of site catchment analysis is that site function and site location are correlated and that inferences can be drawn about function from knowledge of location (Roper 1979).

The primary purpose for site catchment studies, especially in Europe has been the examination of the environmental context of single sites. However for such type of analyses are not concerned with catchments in proper sense of the term. Rather, they may be called site reports in which the site is related to its natural setting by description of the area within a hypothetical radius of the site. This is the area that is presumed to provide the majority of resources to the site. Details of the flora and fauna, water bodies as well as topography of the surrounding territory are represented in drawings and are briefly described. It is also assumed that patterns of exploitation of resources have varied little. 'Where the geographical distribution of essential resources and the technology by which they are exploited have changed little, the pattern of human response might be expected to persist (Vita-Finzi and Higgs 1970). Modern patterns of transhumance have been suggested, therefore, to have existed in early times (Higgs et. al. 1967; Jarman 1972; Noy, Legge and Higgs 1973; Vita-Finzi and Higgs 1970).

Methodology of Site Catchment Analysis

The studies of Higgs (Higgs et al. 1967) and Vita-Finzi and Higgs (1970) have presented two techniques most commonly used for determining the territory to be examined in a site catchment analysis – namely, the use of circular territories of fixed radii and the use of time contours. Both the techniques have been widely used by European as well

as American researchers. A number of European historians (Webley 1972; Barker 1972, 1973, 1975b; Jarman and Webley 1975; Davidson 1976; Jarman 1976) have undertaken site catchment analysis walking 1 hour from agricultural sites and 2 hours from non-agricultural sites. On the other hand, circles of fixed radii are commonly preferred not only by Americans but also Europeans (Barker 1975a; Fagan 1976; Moore et. al 1975; Noy et. al 1973' Clark 1972; Higgs and Webley 1971; Ellison and Harriss 1972; Clarke 1972; Dennell and Webley 1975; Rossman 1976; Zarky 1976; Roper 1974, 1975; Peebles 1978).

Earlier the terms 'territory' and 'catchment' were distinguished for site catchment analysis. The former was defined as the area immediately accessible to a site's inhabitants, which was habitually exploited; the latter as the total area from which the contents of a site were derived (Higgs 1975). Most of the site catchment analysis literature has, however, tended to confuse and merge the two terms. Therefore, 2-hour or 10km (or whatever), territories have been treated as if they were actual catchments and the inhabitants never moved further than say 10km. Another important factor thus emerges regarding the approximate estimation of the shape and size of the catchment area. Several scholars have experimented different techniques to provide empirical data to support the use of some particular catchment size or shape. Findlow and DeAtley (1974) made a preliminary attempt in their analysis of sites in the Animas Valley of New Mexico, formulated two site types and examined the spacing along and across drainages and between sites of same type as well as different types of sites. The observed spacings were taken as an estimate of the size and shape of catchments of different types of sites. Cassels (1972b), on the other hand, constructed Thiessen polygons (Haggett 1965) around each site to determine catchments, and assumed that all sites were contemporary. He too, however, used a set of concentric circles, after determining the size of the polygons, to evaluate resource content and merely presented a frequency distribution of size of polygons. Dennell and Webley (1975) probably used a similar technique, but eliminated overlaps of territories, and examined spacing.

Browman (1976) similarly has used linear spacing of sites and Brumfiel (1976) both used the territories truncated from overlapping sites to evaluate resources. Both linear spacing and Thiessen polygons (or some other measure of spacing), approaches to estimate catchment size and shape have several limitations to their fullest utility. However, so far no attempts have been made to completely solve this problem directly. For site samples that is non-systematic, areally discontinuous or non-contemporaneous, approximation of catchment size and shape using only time distance contours remains a drawback. Flannery (1976a) has attempted to resolve the issue empirically by starting with empirical data on plant, animal, and mineral resources and examining the regions around the site looking for their resources. This seems since some data will be available for most regions as to the resources utilized and this data would enable to formulate approximations of catchments of specific sites. In addition, ethnographic or ethno historic studies can provide data for some areas.

The next step after approximation of the catchment is the evaluation and analyses of resources. General land classifications are used in most analyses. Vita-Finzi and Higgs (1970) have used a series of "land use capability classes", which include irrigated land, arable land, rough grazing, good grazing/potentially arable, seasonal marsh, sand dunes, and irrigated crops. They have evaluated the acreage of the enclosed territory and percentage of it occupied within the contours drawn around each site. Some analyses are based largely on one kind of resource, such as soil or vegetation (Webley 1972; Adams 1977; Roper 1974). However, almost all studies related to site location specify location as being determined by the interaction of several variables. Chisholm (1968) has listed water, arable land, grazing land, fuel, and building material as "the five basic elements of…a settler community's economy: which none can the settlement dispense". Hill (1971) has diagrammatically represented a multivariable model of the determinants of site locations, including critical resources; their proximity and spacing, population density and other variables. The goal of the study is not only to draw inference about why a site is located where it is or how it may have functioned in a settlement system. But a more complete model of settlement location and the settlement system is aimed at, that requires the use of wider variety of resource types. Therefore, the use of a single resource type unfairly limits the scope of such a study.

Various techniques for the analysis of site catchment analysis have been used. Many studies have used tables or drawings of resource zones surrounding the sites to evaluate the data (Banker 1975b). In case of interpretation is assisted with pie diagrams (Vita-Finzi and Higgs 1970) or histograms (Ellison and Harris 1972; Barker 1972) of land type proportions. Roper (1974, 1975) and Baulmer (1976) both used multivariate statistical techniques (for e.g. factor analysis, multidimensional staling, and cluster analysis) for describing and comparing site territories and their resource potential. The assessment of all land types as if they were of equal value for what they produce is commonly applied to many site catchment studies. However, this factor does not work completely due to seasonal and spatial disparities, and which is the reason site catchment analysis was originally developed. Two studies stand apart from most site catchment studies in not confining themselves to a small, circumscribed area surrounding a site. Foley (1977) developed an ecological model accounting for differential productivity in an area, which was free of specific loci. Flannery (1976a) on the other hand, reversed the procedure and started with data on the plant, animal and mineral resources found at sites and analyzing their availability and probable resources zones not within an arbitrarily demarcated area.

But such studies are bounded by several limitations. With the exception of Foley's (1977) and Flannery (1976a) studies, therefore, procedures for site catchment analysis can be summarized as follows. First, the analytic territory is defined using a circle or a number of concentric circles of fixed radii centered on the site or an irregularly shaped territory by the site's relation to its neighbors. In the latter case, the assumption of site contemporaneity needs to be justified. The next step is to measure the area of each resource zone within each site's territory. These figures then should be tabled and

graphed or used in the statistical analysis of site territories. Differential weighting of more distant resources estimates of yields, and accounting for differential seasonal potentials may be used at this point. The exact procedure, however, is chosen and use of results of the analysis will depend on the purpose of the analysis. For the present study, the first method using circular territories of fixed radii has been used extensively as this appeared to best suit the aim of the survey undertaken.

The following sections of this chapter describes the site catchment analysis conducted around the site of Jaidak (Pithad) to understand the reasons for the selection of the site by the inhabitants and the consequent flourishing of the site as an important Sorath Harappan settlement.

Site Catchment Around Jaidak (Pithad)

The survey area falls within 20km radius from the site of Jaidak. The area within 20km radius was divided on the basis of distance contours of concentric circles around the site. They were divided at an interval of 5km for each circle as, 0-5km, 5-10km, 10-15km and 15-20km. The entire area falls within 22º - 23º N latitude and 70º - 71º E longitude (Figure 5). Topographic sheets and the GPS (Global Positioning System) were extensively used to carry out the survey in the area. An on-foot survey was carried out in the circles of 0-5km and 5-10km radii, while the distant circles were covered partially on foot and partially aided by a vehicle. This is so due to the vastness of the region and limited resources. The study was aimed at documenting location and nature of subsistence resources as well as raw material resources. These included cultivated fields, barren lands, pasturelands, type of soil, type of flora and fauna, source of building materials, clay for pottery and other terracotta objects, semi-precious stones, sources of water, etc. within the surveyed area. The satellite settlements have been described below along with the raw material resources located in the radius of 0-20km from the site of Jaidak. The sources of the raw materials used at Jaidak that are not available within the said area but were obtained from other areas have also been discussed.

In this context it is also important to understand the environmental changes that took place over the period of thousand years since the sites were occupied. The study area falls under the dry to semi-arid climatic zone, which is quite similar to the climatic conditions prevailed during the Harappan times. Palaeo-climatic studies in western India have indicated an environment with minor fluctuations within the prevailing dry or semi-arid climate (Singh 1971). The minor fluctuations were but variations in the monsoonal precipitation during the Holocene period that influenced human habitation (Singh et. al. 1990). Studies of the sediments from the Nal Sarovar indicate the beginning of aridity about 3 ka, and therefore, the deterioration of the climate may have set in a couple of centuries earlier. Data from both Rajasthan and the Nal Sarovar show the onset of present-day conditions around 2 ka (Prasad et. al. 1997). Since the landscape during the Harappan period was the same, modern land-use categories can be safely used to reconstruct the past land-use categories. Therefore, it can also be

presumed that the distribution of ancient and modern resource areas correspond to one another.

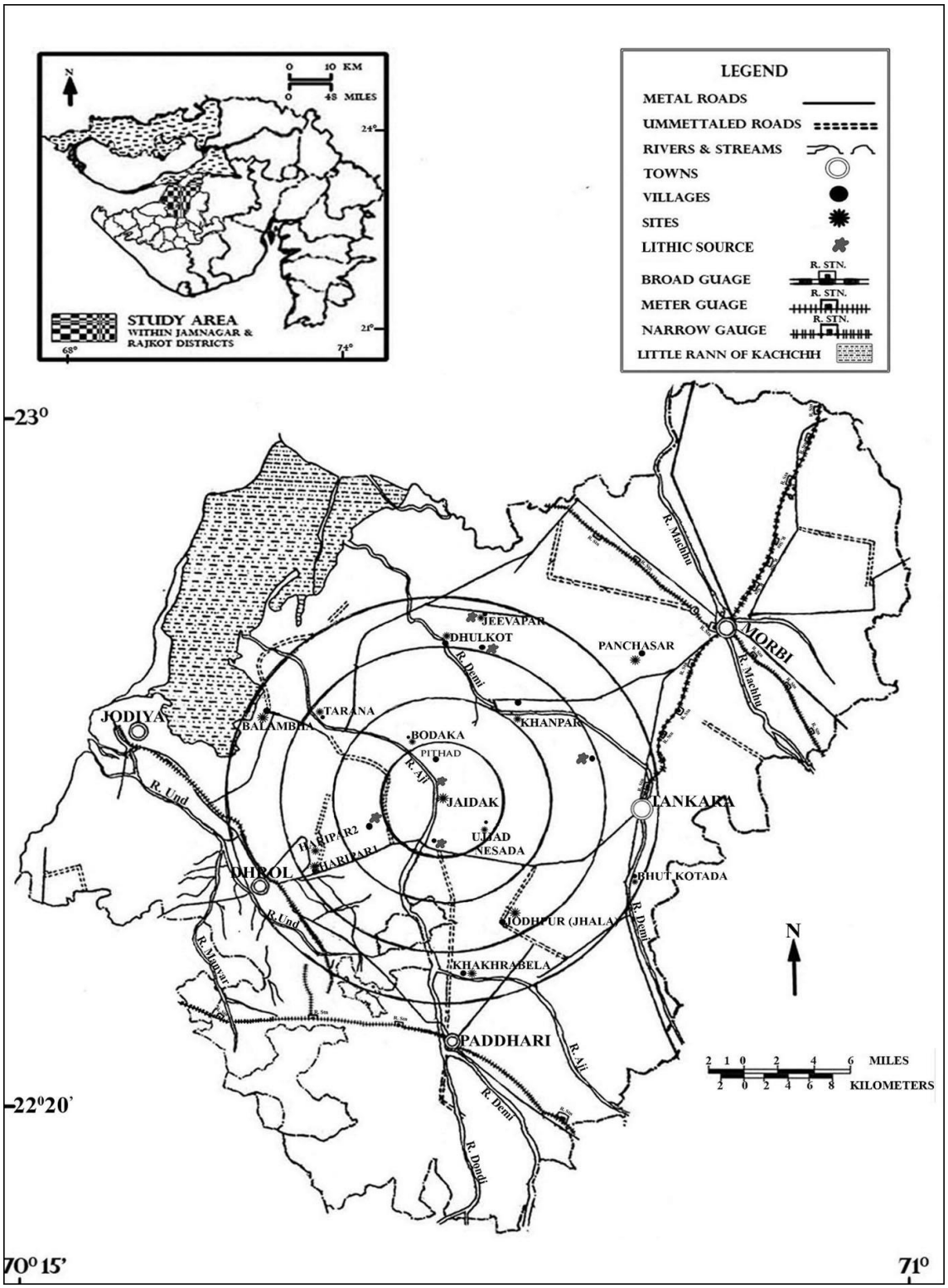

Figure 5: Distribution of Sites and Other Resources within 20km Radius (0-5km, 5-10km, 10-15km, 15-20) of Jaidak (Pithad) (Sen 2009)

Site Catchment in 0-5 km Radius

In the radius of 0-5km of Jaidak, more than 90% of the land is arable, around 7-8% is pastureland and acacia forested and 2-3% land is barren due to stone outcrops. The soil cover comprises mainly of black to medium black soil, besides the river alluvium on both the banks of the Aji river. These soils are highly fertile, and it may be presumed that the ancient farmers must have practiced intensive agriculture in this area. The river Aji is a perennial source of water in the region, providing both for agricultural and domestic purposes. Numerous tributaries and streams flowing from the Aji and several man-made canals have also been drawn with check dams at intervals. Besides, several ponds have been excavated in the area to collect rainwater. All these provide good source of potable water throughout the year to support a flourishing agriculture.

Crops are grown abundantly belonging to the two cropping seasons – *Kharif* and *Rabi.* Crops grown during the rainy season are mainly *Jowar (Andropgare sorghum*), *Bajri (Penicillaria typhoideum*), groundnut (*Arachis hypogaea*), *til* (*Sesamum indicum*), maize. Besides pulses like *urad* (black gram), *moong* (green lentil), *guvar* (cluster bean), etc. are grown in plenty. During the winter season wheat (*Triticum sp.*), barley, *chana* (chikpea), *methi* (fenugreek), mustard, castor, etc. crops are grown. *Jowar* and gram (*Cicer arictnum*) are grown as both *rabi* and *kharif* crop. Besides vegetables like cabbage, cauliflower, potatoes, tomato, brinjal, lady's finger, beans, carrot, sweet potato, etc. are also grown seasonally. Spices and condiments like *jeera* (cumin), *saunf* (aniseed), chilies, garlic, coriander, onion, etc. are also grown during the winters. The most important cash crops grown here are cotton and sugarcane. Also fodder crops locally called *rijkha or godak* is grown in sufficient quantity. Along the fields several trees, shrubs and bushes can be seen. The trees include mango, papaya, tamarind, jamun (rose-apple), neem, eucalyptus, *bor* (*Zizyphus jujube*), *babool* (*Acacia sp.*), date palm, guava, coconut (rarely seen), and also banana. Cactus and other xerophytes of different varieties are found to have been used for fencing the fields and farmhouses in the area. These are the common crops and trees growing in the 20km catchment area of Jaidak.

The pastoral cover of grasslands is abundant in the whole survey region. *Bharward* and *Rabari* communities reside in almost all the villages. It was noticed that in most of the villages these groups with their animals, mostly sheep and goats resided immediately outside the boundary of the village in a fenced area. This might be a temporary shelter and it may also be presumed that this provided easy mobility to the pastures. However, only in a few villages, for e.g., Jasapar, the *Bharward* community of people stayed within the village area and looked after the cattle, sheep, and goats. Cows, buffaloes, sheep, goat, and camel are the most common animals kept at homes. The wild fauna is quite varied. The faunal remains from excavation at Jaidak revealed the presence of pigs, deer, antelope, blue bull or *nilgai*, etc. (Chase pers. comm). These are very common in the whole area.

The region around the site of Jaidak is sufficiently rich to provide the inhabitants of the site with their needs. Pottery kilns found during excavation point to the production of

pottery there. A survey of the present potters in the villages of Pithad, Jasapar and Latipar revealed that clay for pottery was brought from the banks of the river Aji. It is quite likely that the Harappans at Jaidak exploited the same source of clay most conveniently accessible to them. The Trap rock exposed on the riverbed provided excellent raw material for building the fortified settlement with a wide fortification wall at Jaidak. The riverbed also provided with sandstone as raw material for hammer stones, sling balls, saddle querns. The gravel conglomerate exposed in the sections of the Aji river, and its streams have several nodules and large chunks of Agate, Chert, and Chalcedony were used extensively for production of microliths at the site, which although was an elementary production center. Chalcedony outcrops were observed along the banks of the streams and found also as nodules and pebbles. Agate, moss agate, and chalcedony (mentioned above) have their resources in the trap rock outcrops at several places near the villages of *Khijadiya, Latipar, Jivapar, Badanpur, Khakhra, Veratia,* etc. Jasper however has its source near the *Khokhari* village. A brick kiln is located about4.5km northwest of Jaidak indicating the fact that the clay in the catchment of Jaidak is very good. The raw material or a type of whitish clay, perhaps with greater calcium content was used for making lime plaster, is also found in this area within a distance location of 3.5-4.5km south-southeast of Jaidak. It is also a source of '*khara*' type of clay used by the Pithad village potter to add into the clay preparation for making pottery in the present times. Possibly the same source was exploited by the Harappans at Jaidak to obtain the white clay used as plaster as revealed during the excavation.

Satellite Settlements in 0-5 km Radius

Ujjad Nesada Timbo (22º 39.634'N; 70º 36.856'E) is located in the Jodiya taluka of Jamnagar district. The site was originally reported as Bangawadi, a chalcolithic site. But during the course of the present survey this low rising mound was located on the borders of three villages, viz. Bangawadi, Timbdi and Rasnal and is about 2km southeast of Jaidak. No pottery was found at the site, but only a few chipped flakes, debitage and nodules. Therefore it was assumed that the site most likely functioned as a herding unit and for temporary shelter as it is situated very close to pastoral lands and amid cultivated fields. The site is located next to a rain gulley which has exposed chert deposit. The site has a deposit of about 1m and measures 3161.76 sq. m. No natural source of water was observed near the site.

Ujjad Ambada (22º 45.445'N; 70º 32.891"E) is a low rising mound with a height of about 1m located north of Pithad village on the way to village Ambada. The site is a medieval site and covers an area of about 17833.8sq.m. in circumference. The surface collection included pottery, which pointed to its medieval affiliation. Besides few flakes and nodules of chert were also found from the surface.

Site Catchment in 5-10 km Radius

The area within the radius of 5-10km of Jaidak has black cotton soil mainly, along with some lighter and slightly ashy varieties. Arable land in this radius reduces to 85%,

while pastureland increases to 10% and the barren land full of stone outcrop is 4%. The pastureland turns green with tall grasses during the monsoon season. The Aji remains the main source of water to its nearby villages, while a number of ponds may be seen in the area to meet the water needs of the rest of the region. The crops and other vegetation cover do not show any significant change. The pastoral land is amply exploited for rearing the cattle and herding stock. The acacia or *baval (Acacia sp.)* forest were provided for firewood as well as provided pastures for grazing animals. Brick kilns were also found in the village of Latipar. Only one site, Bodaka affiliated to the Sorath Harappan is located within this area.

Satellite Settlements in 5-10 km Radius

Bodaka (22º 41.988'N; 70º 32.504'E) is located about 7km northwest of Jaidak in the Jodiya taluka of Jamnagar district. The site is locally known as *Lakhan Timbo or Tapovan.* It is located on the right bank of the river Aji and the mound rises to a height of about 5m. The exact size of the site is difficult to determine because the site has been considerably damaged due to cultivation. The pottery and other artifacts collected from the site confirms to the occupation of the site during Rangpur IIB as well as IIC phase (Figure 6). The areas around the site are mainly acacia forested and pasture lands. The soil is the commonly found black cotton. A well has been excavated on top of the mound in recent times. A portion of a stone wall (?) or structure is visible in the well section. Exploration around the mound yielded rim sherds of several vessels such as fine red ware convex and concave sided bowls, globular pots with clubbed rims, a perforated body sherd and an elongated stud-handle which belongs to the late phase. Other artifacts include pottery discs, terracotta ear studs and flakes and debitage of chert mainly. The site appears to extend to a wider area on the other side of the metal road where the mound is much lower. A brick kiln is located within about 1km south of the mound towards the Pithad village.

Site Catchment in 10-15 km Radius

The arable land within the radius of 10-15km declines slightly to 82%, while the pastoral area increases to 12% and the stony barren area shows a further increase to about 6%. The soil is mainly black, with some areas covered by slightly loose, ashy grayish soil. The area is watered by the two rivers Aji and Demi and their channels. Small streams like the Gogam and the Bhavni also flow in this area. Lakes, ponds, and wells are also a common feature in the northwestern to the eastern parts of the area under study. While southwestern and western parts are observed to be more arid and land with exposed rock outcrops of the Demi riverbed appears to have also provided raw materials like chert, chalcedony, and quartz for the production of lithic objects.

The Harappans in this area exploited the arable land and the huge pastoral area, which is evident by the fact that four satellite settlements were located in the area. Three sites - Tarana, Khanpar and Jodhpar (Jhala) - are larger settlements with ample material remains belonging to the Sorath Harappan. Haripar-1 is comparatively a smaller site. One Mesolithic site (Haripar-2) has also been found in the area.

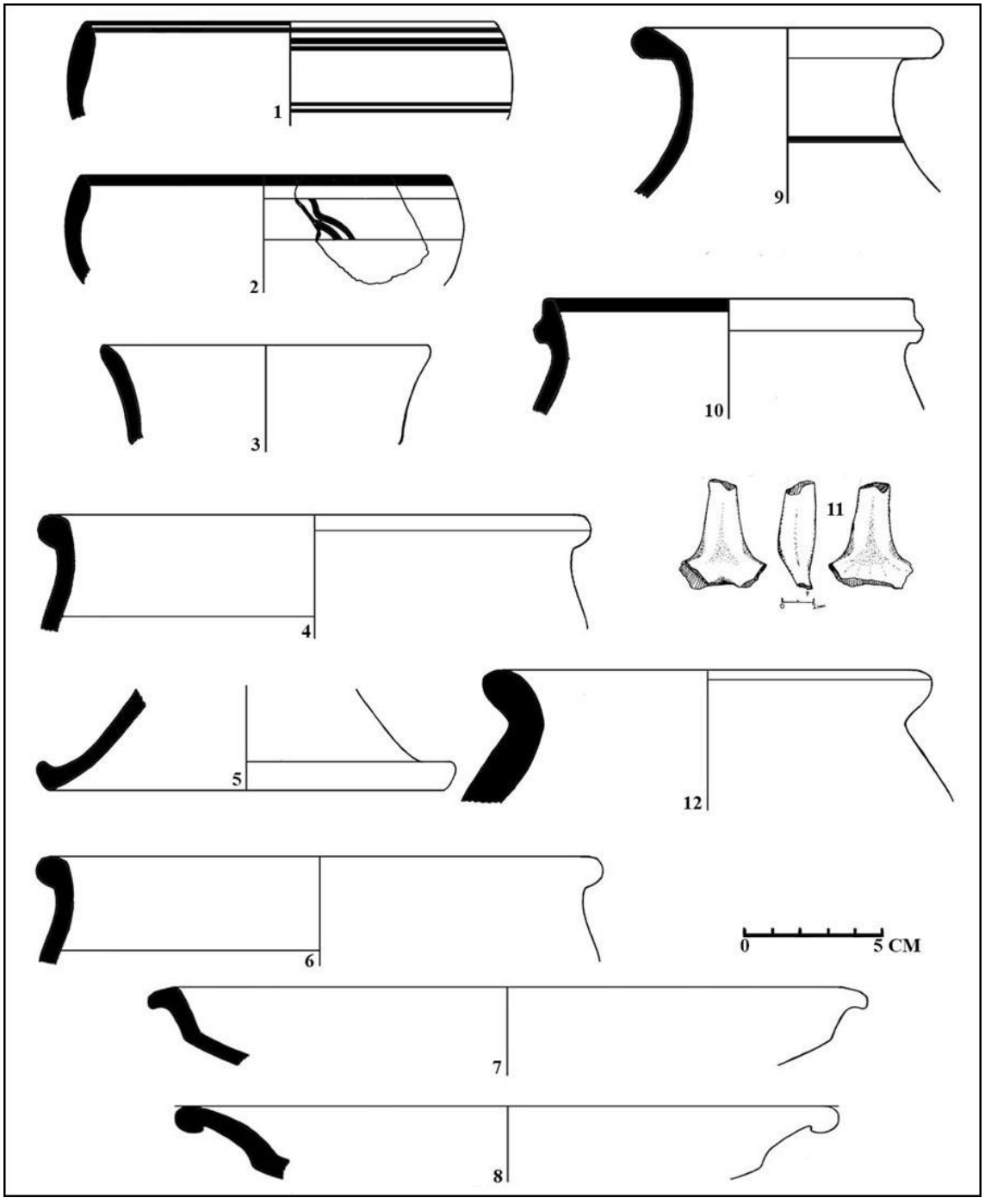

Figure 6: Ceramics from the site Bodaka (Lakhan Timbo)

Satellite Settlements in 10-15 km Radius

Tarana (22º 48.052'N; 70º 28.821'E) has been reported as a multicultural site by Bhan (1983). However at present the site is highly damaged due to collapse of the houses on the mound by earthquake and also partially due to cultivation. Only the mound with evidence of Sorath Harappan affiliation could be located. The site is locally known as *Maldi-no-timbo*. It is located on the right bank of the Aji river about 14km northwest of

Jaidak in the Jodiya taluka of Jamnagar district. The circumference of the mound cannot be assessed due to presence of the collapsed debris. The mound is about 6-7m in height. Cultivated fields with crops of wheat and cotton surround the site. The soil here is black cotton. The Harappan pottery belonging to Rangpur IIB and IIC were collected during exploration. This assemblage comprises of rims of Fine red and buff ware bowls and pots, bases and also undiagnostic sherds of coarse red and gray ware were found (Figure 7). Flakes and debitage of chert and chalcedony were also found in the surface exploration. A very small portion of the mound is accessible and was explored.

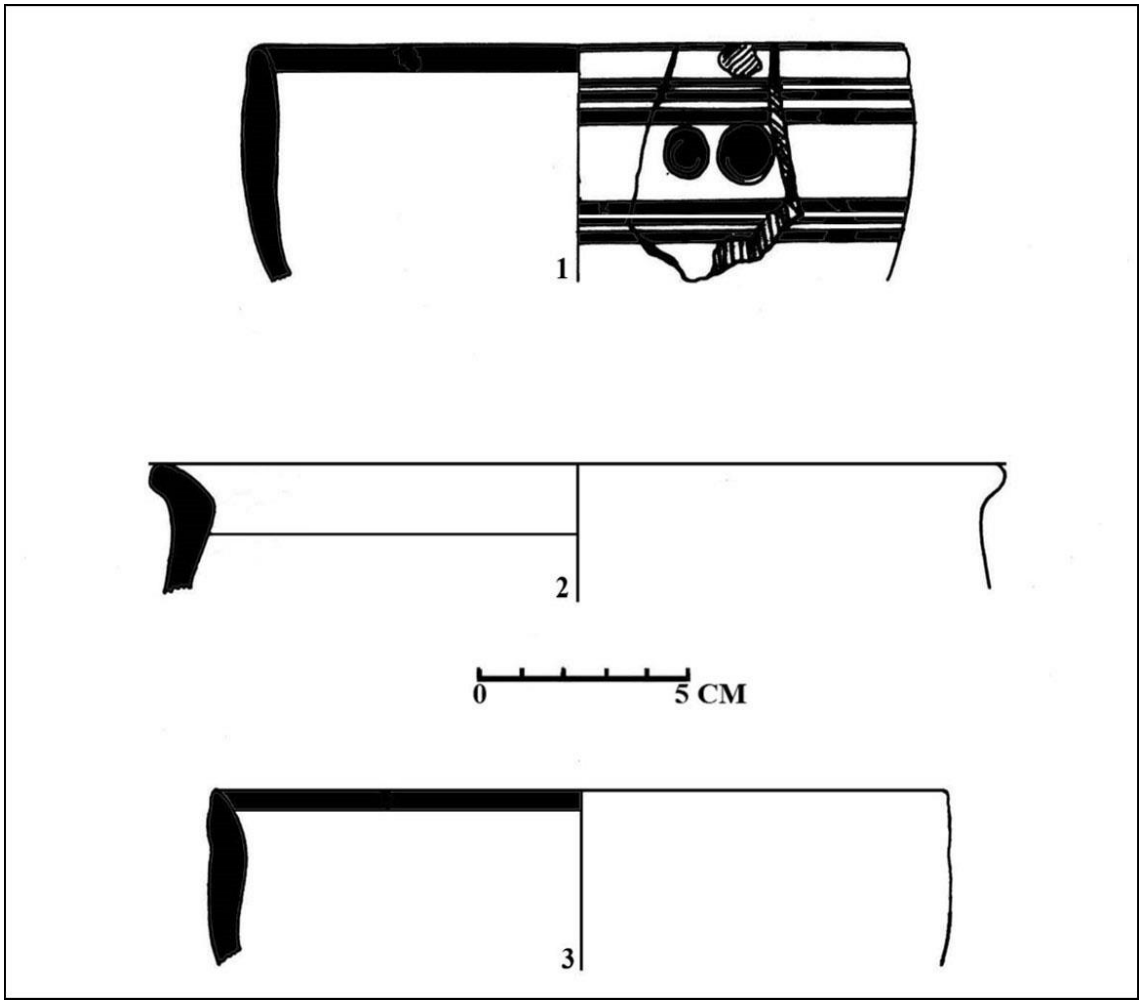

Figure 7: Ceramics from the Site Tarana

Haripar 1 (22º 34.594'N; 70º 26.656'E) falls within the jurisdiction of Dhrol taluka of Jamnagar district. The site is located about 13km southwest of Jaidak on the left bank of the Bhavni channel, emerging from the Und river. The site has been completely destroyed by cultivated fields. The soil here is mainly black cotton. Some areas of the fields have slightly *kankary* soil which is favorable for growing groundnut. The pottery and other artifacts found from the site belong to the historic period. Besides few cattle bones were also recovered.

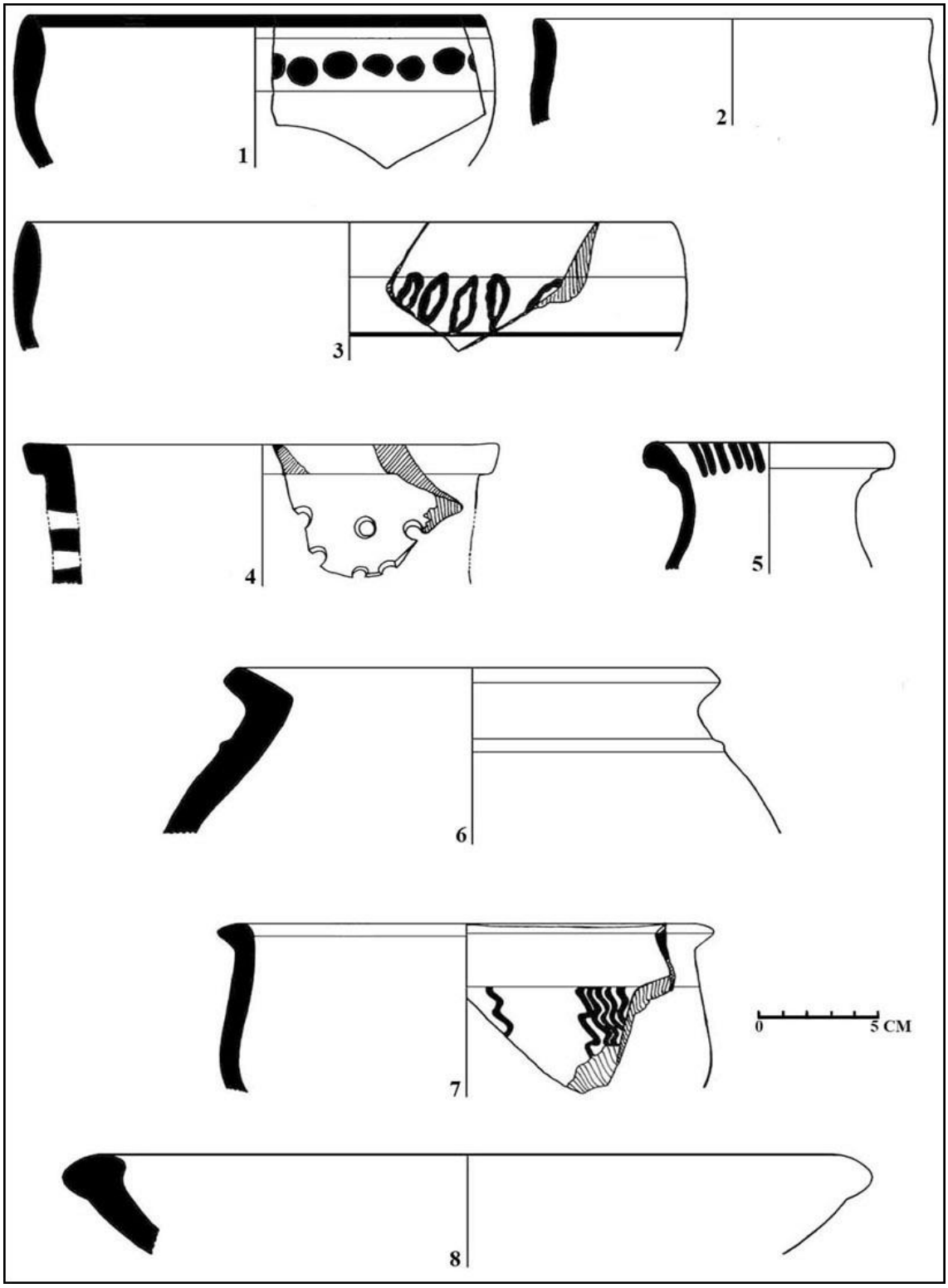

Figure 8: Ceramics from the Site Khanpar

Haripar 2 (22º 35.373'N; 70º 26.145'E) is a mound located within 1-1.5 km north west of the village of Haripar on a cart tack road. The mound is about 5m in height and is 7641.15 sq. m. approximately in area. Parallel sided blades, retouched flaked, fluted

core made on chert, chalcedony and agate along with debitage was found on top of the mound. The evidence from the site does not indicate a primary production centre of the Mesolithic period, but the inhabitants were definitely engaged in secondary working and chipping activities. The site seems to have been a herding unit. The site is surrounded by cultivated fields and pasture area also lies next to the fertile fields.

Khanpar (22º 44.372'N; 70º 38.232'E) is located about 11km northwest of Jaidak in the Morbi taluka of Rajkot district. The site is located southeast of the village of Khanpar on the right bank of the Demi river. The site is locally known as *Bhua-Padar-no-Dhoro*. A huge water tank called *Gomteshwar talav* lies on the left side of the mound. The mound covers about half a kilometer in area but is partially destroyed by cultivated fields. A cart track has also been cut through the mound which goes to the interior of the village. Bed rock is found exposed in the rain gulleys. Also blocks of dressed stone were found scattered, but structures could not be located due to dense acacia vegetation on the mound. The left side has also been cut due to excavation on the tank. The area has black cotton soil and the crops grown in the fields are mainly wheat and cotton. Pasture land is also lies next to the fields. The exploration has yielded a considerable amount of pottery belonging to the Sorath Harappan / Urban phase Harappan (Rangpur IIA-IIB) and Post-Urban Harappan (Rangpur IIC). The ceramic assemblage includes convex and concave sided bowls both of fine red and buff ware, pots with clubbed rims, basins, perforated pottery sherds, as well as coarse red ware sherds (Figure 8). Other antiquities include pottery discs, a pestle stone, a hammer stone and lithics.

Jodhpur Jhala (22º 32.953'N; 70º 37.687'E) is located about 12km south of Jaidak in the Tankara taluka of Rajkot district. The site is located on the right bank of the Gogam river, a tributary of the Aji river. The site has been completely destroyed by cultivated fields. The area has a slightly *kankary* variety of black cotton soil. The site has Harappan occupation with a long sequence starting from the Mature Harappan (Rangpur IIA-IIB) to the Lustrous Red ware (Rangpur III) (Figure 8). The area on the bank of the river has outcrops of quartz therefore the site could have been utilized for exploiting these raw material resources. Besides pottery assemblage representative of the long sequence of occupation at the site, rolled collumella, pottery discs, as well as fluted cores and flakes of chert, agate and quartz have been found.

Site Catchment in 15-20 km Radius

In the area of 15-20km radius of Jaidak, the arable area increases to about 85%, while a decrease is noticed in the pastureland to 10% and also a slight decrease in the area covered by the outcrops of stones to 5%. The area within the above radius to the south and southwest of Jaidak is still observed to be comparatively barren with exposed stony surface than the rest of the area. The cultivated land increases towards the north, northeast and southeast portions of the area covered. This is owing to the fact that the latter areas are watered by the Demi river and its tributaries. On the other hand the increasing aridity of the western region of the survey region might be due to the close

proximity to the Little Rann of Kachchh. The soil in this area has brown silt soil along with black soil. The agricultural societies in this area exploited the resources lying in this area profitably is evident from the presence of fairly bigger sites like Dhulkot, Balambha, Bhut-Kotada, etc. Three other settlements with a substantial spread are also found in this area. Almost all the sites are located on the banks of the rivers Demi and Aji which are the main sources of potable water in the area.

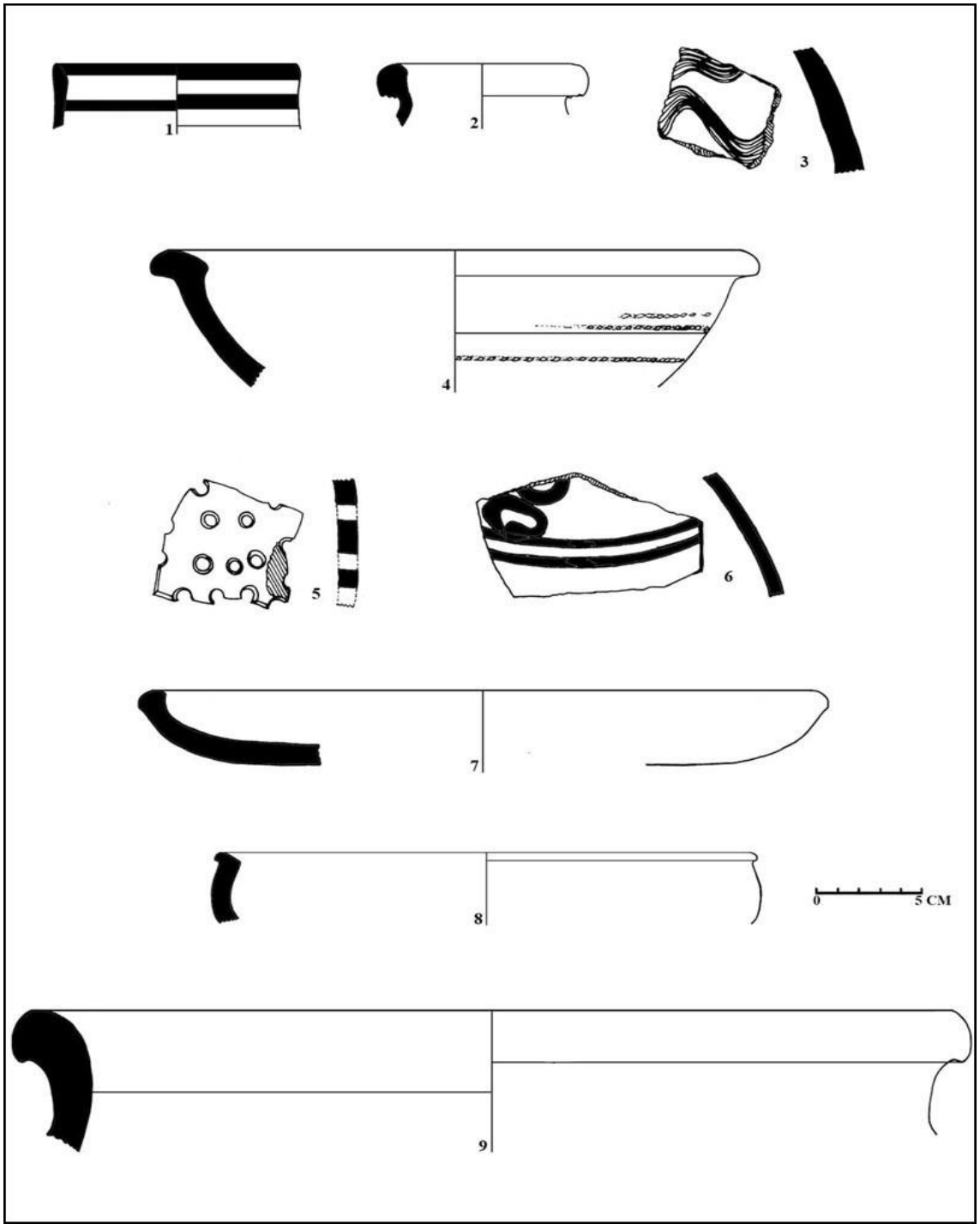

Figure 9: Ceramics from the Site Jodhpur (Jhala)

Satellite Settlements in 15-20 km Radius

Dhulkot (22º 47.547'N; 70º 34.422'E) is a multicultural site, which has both Harappan and historical deposit. The ancient name of the village of Dhulkot is *Kankotnagari*. The site is located in the Jodiya taluka of Jamnagar district, about 16km north of Jaidak. The mound is locally known as *Ghodvado* and is located on the southern edge of the village on the right bank of Demi river. The mound is cut by a cart track and is densely vegetated with acacia making it quite difficult to reach most of its area. The mound also has been destroyed partially by construction of modern houses and cultivation. This is a high mound of about 5m and spreads to an area of more than 4 hectares on the river bank. The soil around the site is light brownish sandy silt of river bank. Fertile agricultural lands are present around the site. Pastoral grounds are also nearby. Pottery belonging to both Harappan, but Late phase (Rangpur IIC) and medieval period were found during exploration. The pottery is mainly fine red ware. Mostly body sherds were found.

Balambha (22º 42.633'N; 70º 25.311'E) is located about 18kms northwest of Jaidak. The site is known as *Binanagari*. K. K. Bhan (1983) had reported the site as located on a hillock. However due to recent earthquakes in the region and subsequent cutting and clearing of the area and converting it into the village of Navi Hirapur has completely destroyed the site. About half a kilometer north of this village, in a slightly raised area locally known as *Mama-Saheb-no-dera* in the midst of cultivated field meager evidence of occupation during the Harappan as well as the historical period has been found. A small stream flows past the fields. Few sherds of both Post-Urban Harappan (Rangpur IIC) and medieval pottery have been found in the survey. Also, few chipped chert nodules with cortex and a highly rolled pottery disc are among other antiquities. Due to destruction of the site the actual size is difficult to ascertain.

Bhut - Kotada (22º 49.985'N; 70º 36.334'E) is located 19kms east of Jaidak in the Tankara taluka of the Rajkot district. The site is located on the right bank of the river Demi and rises to a height of about 6m. The mound measures 28863.1 sq. m. approximately. Cultivated fields are present next to the mound. The soil is a slightly grayish variety of the black soil. A buttress built of stone blocks still stands on the northwest corner of the mound indicating the fact that there was a fortification during the historical period in all probability. The site has been partly disturbed due to the modern construction of temples on mound and cutting by the river. Exploration on and around the mound yielded ample evidence of Sorath Harappan occupation from the pottery sherds belonging to Rangpur IIB and IIC at the site. A broken rim of the "Saurashtran lamp" and single banded agate flake with cortex was found in the survey.

Jeevapar (22º 49.985'N; 70º 36.334'E) is located within 18-19kms north of Jaidak in the Jodiya taluka of Jamnagar district. The site is locally known as *Jan-no-dhoro*. The mound has a deposit of 1m. Since no pottery was found at the site during the present survey, the site may be assumed to be a herding unit of the Harappans since it lies next to

pastoral grounds. The site could have been occupied during the Mesolithic period, however no direct evidence indicating this fact was found and it remains only an assumption. Cultivated fields also are located next to the mound. The only source of water is a tank (*Shakti-mata-no-talav*) located near the site. The soil is different here with sandy red along with patches of salty wasteland. Only rolled flakes and nodules of chert, chalcedony, quartzite and milky quartz have been found during the exploration.

Khakhrabela (22º 28.774'N; 70º 37.210'E) is located 17km southwest of Jaidak in the Paddhari taluka of Rajkot district. The site has been completely destroyed by cultivation but evidence of occupation during the Harappan (Rangpur IIC) and medieval period could be discerned from the collection of artifacts in the fields. The site lies on the right bank of the Aji river and rises up to a height of 5m from the river bed. Bed rocks are found exposed on the edge of the mound on the bank of the river. The soil here is black cotton. The probable extent of the site is difficult to estimate, but it definitely spreads over along the riverbank to some distance. Some stones were found exposed on the edge of the mound facing the river, but their association with structures is not clear.

Raw Materials from Distant Places

The raw materials used for manufacturing various artifacts found at the site of Jaidak were commonly procured from its catchment area. The most commonly used material is clay for making pottery and clay objects. This is followed by various other materials like chert, chalcedony, agate, jasper, amazonite, carnelian, quartz, quartzite, sandstone, steatite, faience, copper, shell and granite. The resource for some of the raw materials is located beyond the range of 20km since they could not be located within the catchment area.

Copper: Copper objects are very few at the site. However there is ample evidence to prove copper working activity being carried out at Jaidak. The source for copper for the Harappans has been proposed to be the Aravallis and Khetri located near Jaipur by several studies (Agrawal 1971). The Harappans in Gujarat must have exploited the local resources. In this context mention may be made of the occurrence of copper ore in Gujarat at Amba Mata in North Gujarat and is also found in Amreli district (Dhavalikar et. al. 1996). Following are the four different localities in Gujarat reported to contain copper deposits (Raghunandan et. al. 1981): (a) Devi Ambamata belt which extends from the Sabarkantha district to Sirohi district in Rajasthan; (b) Kui-Chitrasani belt in the Banaskantha district to Sirohi district in Rajasthan; (c) Champaner belt in the Panchmahals and Baroda district; (d) Native occurrences in the Deccan Trap area of the Jamnagar, Bulsar (or Valsad) and Rajkot districts. Thus, for the Harappans at Jaidak obtaining copper from the surrounding region in the Jamnagar and Rajkot districts appears to be the most feasible source, although there are no direct evidence of exploitation of these sources during the Harappan times. The other source areas mentioned above fall beyond the immediate resource catchment area of the site and therefore required long distance transport.

Variegated Jasper: This is a rare and priced semi-precious stone, which was used to make beads at Harappan sites. The source for this raw material is the Deccan Trap formation in the Jamnagar district near the *Khokhari* village (Gazetteer of India 1970), although this does not fall within the 20km catchment area of the site of Jaidak. Variegated jasper was a prized item and the fact that this particular raw material was found stockpiled at Bagasra (Sonawane et. al. 2004; Bhan et. al. 2005), a Classical Harappan site located 50km northeast of Jaidak, clearly indicates its importance in the context of Harappan trade. Although the assemblage at Jaidak is found to contain several flakes and nodule pieces which were exclusively used for bead production. Only one sample of an unfinished, thick disc shaped jasper bead with incomplete perforation at the centre was reported from the site. This was found in 1992 (IAR 1991-92) from the southeastern extension of the site known as Jaidak II.

Carnelian: Beads made of carnelian are very few from Jaidak. There is no evidence for bead making at the site, but such evidence was found at the Classical Harappan site of Bagasra and Lothal. These beads perhaps entered Jaidak as an object for exchange for other materials. Agate deposits in surrounding region of Jaidak have already been mentioned in the previous section. These along with other sources in the Bharuch district and in central Kachchh must have provided the Harappans with substantial amount of raw material for producing carnelian and the beads there from. Thus, Jaidak could have acted as an agency for obtaining these raw materials from the accessible resources and supplying them to the Harappan production centers at Bagasra etc.

Shell: Shell could have been brought from the Saurashtran coast of the Gulf of Kachchh, which lies 30km north of Jaidak. Isolated fragments of *T. pyrum* and *C. ramosus* as well as beads, broken bangles, and shaped collumella objects have been reported from the site.

Amazonite: The most likely source of amazonite occurs in Gujarat itself. It occurs in granite pegmatites southeast of Palanpur, near the village of Derol (Foote 1898) and amazonite pebbles can be found in the bed of the Sabarmati River (Law 2008). These regions lie beyond the presently surveyed 20km catchment area. However, at Jaidak amazonite beads number only two, whose occurrence appears to be accidental or as a result of internal exchange of objects with other Harappan sites. But at the site of Nagwada which is about 125km southwest of the Sabarmati amazonite resource area, the excavators have found chert drills along with abundant remains of amazonite beads in "different stages of manufacture" (Hegde et. al. 1988).

Discussion and Conclusion

The site catchment analysis has shown the presence of black cotton, alluvium and little brown silty soil and some pasture areas in the catchment of Jaidak. The survey of sites revealed their nature as being satellite settlements in the area. It may be presumed from the nature of artifacts found at these satellite settlements, that the inhabitants of the entire catchment area exploited the fertile land in the area for agricultural as well as pastoral purposes. Thus it was observed from the study that agriculture and

pastoralism or animal rearing played an equally important role in the economy of Jaidak.

The presence of small or satellite settlements around large fortified settlement of Jaidak in the Sorath Harappan context points to the presence of some hierarchical order of the society at that time. Although there is little evidence for major craft activities, except for the production of pottery and to some extent copper working, it may be pointed out that the Sorath Harappans were well acquainted with the use of Classical Harappan objects. This is evident from the presence of finished copper, shell ornaments and carnelian beads. Nevertheless, it appears that Jaidak played a significant role in the procurement and preliminary process of sorting and selection of the raw materials meant for supply to major craft production centers such as Lothal, Dholavira, Bagasra, etc. This may also indicate another fact that the people of Jaidak seem to have produced enough surplus to exchange agricultural products for certain trade objects like copper and a few ornamental beads. Thus, the flourishing as well as declining stages of economy in the urban and post-urban phases is well reflected in the economy of Jaidak.

The site catchment analysis shows that the agro-pastoralist societies settle and exploit resources from the closest areas and do not move very far away from their habitation as the Hunting–gathering societies. At Jaidak the area within the 0-5km radius is the richest reserve of all the basic necessary resources and was extensively exploited for sustenance of the inhabitants at the site. Most of the sites located within the survey region are smaller in size and appear to have a rural based economy. The only large urban settlement in the area is Jaidak. However, these satellite settlements are located in close proximity to the sources of several raw materials used at Jaidak and therefore a general interdependence is hinted at. The importance of the location of these sites in the surrounding territory of the site of Jaidak lies in the fact that they played a significant role in the procurement process of several raw materials, mainly lithics and copper. These materials were, in turn, dispersed to other Classical Harappan craft production centers such as Lothal or Bagasra after undergoing a preliminary checking or sorting process at Jaidak. Not only that in the Post-Urban phase when a general economic decline had set in with the disintegration of the Classical Harappan settlements, the economic stability at Jaidak had not been devastated completely. The agricultural productivity at Jaidak was further supported by the products from these small sites which are located near the rivers and in patches of cultivable soil. Besides, the inhabitants were further provided with wild plant products and animal hunting from neighboring areas. Thus, the large population at Jaidak was supported by a substantial supply of food which did not lead to the large scale shifting of the population. Moreover, craft activities also continued at the site with vigour since raw materials were procured and provided by the satellite settlements. Thus, the large fortified Harappan settlement at Jaidak was extensively supported by the small sites located in its surrounding areas and aided ably in the exploitation of the rich resources present in the region and thereby ensured the long endurance of the settlement.

Notes

[1] *The survey was undertaken as a part of the Doctoral Dissertation of Dr. Bratati Dasgupta (Sen 2009).*

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