Chapter 6

Site Catchment Analysis of Jaidak (Pithad)
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6.1 Introduction

This chapter deals with the study of the spatial distribution of the cultural relics occurring at the site of Jaidak (Pithad). With this aim a survey of site-catchment with focus on area within 20km radius with Jaidak as its epicenter was undertaken. The study further seeks to infer the economic activities that were performed within the area.

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).

6.2 Definition and Scope of Site Catchment Analysis

Before discussing the catchment analysis of a site it is appropriate to define what the investigator means by an archaeological site. Although various archaeologists have
worked extensively to define a site, the basic concept remains the same. (Plog et al. 1978; Willey and Philips 1958; Heizer and Graham 1967; Plog and Hill 1971; Hole and Heizer 1973; Thomas 1975; Doelle 1977; Schiffer and Gumerman 1977; Dincauze et. al. 1980). Thus site may be defined as an area with definable spatial boundaries where artifacts are found. An artifact means any object that is made or used by man and is the basic unit of archaeological analysis.

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 application of site catchment analysis is diverse among the British and American researchers. This is quite different contexts in Europe and Americas. Earlier British archaeology was mainly concerned with artifacts and historical reconstructions of their development. In the late 1960s, a new approach was made to explain the cultural phenomena not only by culture alone, but also other factors, including economy. Since then the study of economies has become an important theme of research.

An important feature of site catchment analysis in British archaeology was the relative importance of the economy or subsistence activities in early society. Vita-Finzi and Higgs (1970) have assumed that a population will take full advantage of all the resources available within a certain limit of their habitation. The importance of subsistence activities is assumed to be such that the pattern of economic exploitation can be directly derived from percentages of land use types in the catchment area. However, practically it appears to be difficult to determine the relative importance of economic activities such as animal grazing and cereal cropping. The reason for this is that the size of the catchment area is often, chosen arbitrarily and therefore percentage of land type within the catchment area can only be approximations. Several other studies (for e.g. Barker 1972, 1973, 1975b) primarily aimed at culture-historical reconstructions from the perspective of economies, and in doing so generated hypotheses about those economies by using site catchment analysis. Conversely certain other studies (for e.g. Webley 1972;
Jarman and Webley 1975; Davidson 1976; Jarman 1972, 1976) were seeking to examine the economic aspects of various cultural units. All studies dealing with interpretation of the archaeological record and role economy in it using site catchment analysis, attempts to interpret the relation between site location and potential for occupation. However, to this end, the studies were further supplemented by other locational techniques of land use.

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).

Site catchment analysis is only in the formative stage in the Americas. American archaeology has, however, a strong tradition of settlement pattern analysis. The settlement pattern concept is a functional rather than a historical concept. Some studies (e.g. Rossman 1976; Zarky 1976) have been performed in similar lines as that of some of the British studies. Site catchment analysis has been used in American archaeology primarily for modeling the spatial distribution of functionally distinct sites within a settlement system, or for examination of the resource potential of sites thought to have occupied different positions in a settlement system. The data was used to assess the locations of each site. Peebles (1978) study was mainly concerned with the examination
of resource potential at functionally different sites using soil from the area and their estimated yield. He hypothesized upon a relation between estimated productivity and site size, assuming that there exists a relationship between population size and subsistence base, between settlement size and resident population, and between area of scatter and settlement size.

Brumfiel (1976) following Peebles, but using linear regression, attempted to predict site size from productive potential – a measure derived from data on available land and fertility of that land. Browman (1976) used site catchment analysis to derive predictions about expected spacing of several sites types, which were then compared with actual spacing of several sites. Finally, Hassan’s (1975) use of the catchment concept may be noted. He discussed the correlation between population density, size and growth rate. He notes “population size is a function of the population density and area”. He incorporates the catchment concept as a measure between size and density.

6.3 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 could also help 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 scaling, 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.

6.4 The Area of Research

The study area of the present research is situated in the region that covers parts of the Jamnagar and Rajkot districts. It includes the Sorath Harappan site of Jaidak (Pithad) and its catchment area. 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 of Jaidak (22°39" 5'N; 70°34" 43'E) is located in the Jodiya taluka of the Jamnagar district. The site is about 4.5km southeast of the village of Pithad, on the right bank of the river Aji that drains into the Gulf. 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. Therefore major portion of the survey area is fertile and the area is drained by the river systems of the Aji and the Demi. The southern parts, on the other hand, represent a rather undulating landscape with scattered vegetation and cropping.

6.5 Site Catchment around Jaidak (Pithad)

The survey area falls within 20km radius from the site of Jaidak. The area within 20km radius was divided based 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 22° - 23° N latitude and 70° - 71° E longitude (Figure 6.1). 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 location and nature of subsistence resources as
Figure 6.1 Distribution of Sites and Other Resources within 20km Radius (0-5km, 5-10km, 10-15km, 15-20) of Jaidak (Pithad)

- 200 -
well as raw material resources. These included cultivated fields, barren land, 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 this area as well as the numerous sites located here. 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. Palaeoclimatic 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, 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 more or less 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.

6.5.1 Site Catchment in 0-5km 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, a number of ponds have been excavated in the area to collect rain water. 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 farm houses 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 also 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 river bed provided excellent raw material for building the fortified settlement with a wide fortification wall at Jaidak. The river bed 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 have been used extensively for production of microliths at the site, which although is a 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 about 4.5km 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 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.
6.5.1a Satellite Settlements in 0-5km radius

1. **Ujjad Nesada Timbo** (22° 39.634'N; 70° 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. in circumference. No natural source of water was observed near the site.

2. **Ujjad Ambada** (22° 45.445'N; 70° 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.

6.5.2 Site Catchment in 5-10km 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 pasture land increases to 10% and the barren land full of stone outcrop is 4%. The pasture land 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.

6.5.2a Satellite Settlements in 5-10km radius

3. **Bodaka** (22° 41.988’N; 70° 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 6.2). 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 section of the well. Exploration around the mound yielded rim sherd 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.

6.5.3 Site Catchment in 10-15km 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
Figure 6.2 Ceramics from the site Bodaka (Lakhan Timbo)
streams like the Gogam and the Bhavni also flow in this area. Lakes, ponds and wells are also a common feature in the north western to the eastern parts of the area under study. While south western 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 Jodhpur (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.

6.5.3a Satellite Settlements in 10-15km radius

4. **Tarana** (22° 48.052'N; 70° 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 6.3). 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.

5. **Haripar-1** (22° 34.594'N; 70° 26.656'E) falls within the jurisdiction of Dhrol taluka of Jamnagar district. The site is located about 13km southwest of Jaidak
Figure 6.3 Ceramics from the site Tarana
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.

6. **Haripar2** (22° 35.373'N; 70° 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 withdebitage 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.

7. **Khanpar** (22° 44.372'N; 70° 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 Gomteshwvar 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
Figure 6.4 Ceramics from the site Khanpar
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 6.4). Other antiquities include pottery discs, a pestle stone, a hammer stone and lithics.

8. **Jodhpur Jhala** (22° 32.953’N; 70° 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 6.5). 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.

### 6.5.4 Site Catchment in 15-20km Radius

In the area of 15-20km radius of Jaidak, the arable area increases to about 85%, while a decrease is noticed in the pasture land 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.
Figure 6.5 Ceramics from the site Jodhpur (Jhala)
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.

6.5.4a Satellite Settlements in 15-20km radius

9. **Dhulkot** (22° 47.547’N; 70° 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.

10. **Balambha** (22° 42.633’N; 70° 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 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. Also few chipped nodules with cortex of chert and a highly
rolled pottery disc are among other antiquities. Due to destruction of the site the actual size is difficult to ascertain.

11. Bhut-kotada (22° 49.985'N; 70° 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. The soil is 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 due to modern construction of temples on mound and also 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. Cultivated fields are present next to the mound. A broken rim of the “Saurashtran lamp” was also found. A single flake with cortex of banded agate was also found.

12. Jeevapar (22° 49.985'N; 70° 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-dhor. 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-notalav) 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.
13. **Khakhrabela** (22° 28.774'N; 70° 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 river bank 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.

### 6.5 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.

#### 6.5.1 Copper:

Copper objects are very few at the site. However there is ample evidence to prove copper smelting activity being carried out at Jaidak. The source for copper for the Harappans has been predetermined 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 and is also found in Amreli district (Dhavalikar et. al. 1996). Four different localities in Gujarat have been reported to contain copper deposits. They are as follows (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, Bilsar (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.

6.5.2 Variegated Jasper:

This is a rare and priced object, which was used to make beads at the Harappan sites. The source for this raw material is the Deccan Trap formation in the Jamnagar district itself 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. Yet only one sample of a large thick disc shaped jasper bead with incomplete perforation at the centre was reported in 1992 (IAR 1991-92) from the south eastern extension of the site known as Jaidak II.

6.5.3 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.

6.5.4 Shell:

Shell could have been imported 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.

6.5.6 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 definitely 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).

6.6 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 for 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.