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M. Rafique Mughal

**THE CONSEQUENCES OF RIVER CHANGES
FOR THE HARAPPAN SETTLEMENTS IN CHOLISTAN**

Changes in the courses of the Indus and Hakra Rivers systems of the Greater Indus Valley have profoundly influenced the settlement patterns and have induced significant cultural changes which have now been documented archaeologically. The evidence suggests that the origin, climax and decline of the Indus Valley Civilization between the late fourth and second millennium B.C., were intimately linked with the environmental changes generated by the shifting river regimes. The relationship between the rivers and the development of civilization is best exemplified in the east-central Indus Valley comprising the Cholistan desert of Pakistan.

The subject of river changes in the upper Indus Valley to which the ancient Hakra River, called Ghaggar in India, was an integral part, has been discussed and debated upon by several scholars since the last century (Oldham 1893; Whitehead 1932; Stein 1942), as summarized by Lambrick (1964: 229-236) and illustrated by a series of maps by Wilhelmy (1969). Further studies of the palaeo-channels of the various rivers have been carried out recently with the help of landsat pictures (Ghose *et al.* 1979; Pal *et al.* 1984). Their ecological implications have been discussed by Agrawal and Sood (1982), Francfort (1986), Misra (1984) and Raikes (1968). The emerging picture vividly illustrates the hydrographical pattern of the ancient landscape, apparently carved out by frequent changes of the river courses, all of which once flowed from the Siwalik foothills towards Cholistan and down to the Rann of Kutch. A general sequence of the river changes of far-reaching cultural consequences in the entire upper Indus region including the Indo-Gangetic Divide, is being reconstructed by the dateable evidence. In the Cholistan desert of Pakistan, intensive

M. RAFIQUE MUGHAL is Director, Department of Archaeology, Government of Pakistan, Lahore.

explorations carried out along the now dry bed of the Hakra River, have provided overwhelming archaeological evidence to date the various channels with reasonable accuracy at least from the fourth to the first millennium B.C. The present paper is an attempt to relate the river changes to shifts in the settlement locations and consequent cultural changes occurring through time until the abandonment of Cholistan around 1000 B.C. when the Hakra River had dried up completely.

Among the 414 sites so far documented in Cholistan, 264 belong to the Early, Mature and Late Harappan Periods of the Indus Civilization (Mughal 1982, 1990a). In addition, 99 sites represent an early Hakra Wares Period, and 14 sites belong to the Painted Grey Wares (PGW) of the first millennium B.C., making a total of 377 sites. The sites fall into several distinct categories: industrial, where craft related activities and kilns for firing of pottery and other materials are concentrated; multifunctional sites consisting of settlements with specialized activity areas in or near the habitation area; purely habitational sites; camp sites marking temporary occupation by herders and graziers; and two cemetery sites. The available data is of vital importance for understanding the settlement patterns and their changing densities through time within the time-range or cultural horizon of the Indus Civilization.

THE HAKRA RIVER AND THE SETTLEMENT LOCATION

Hakra Wares Sites

The sites associated with Hakra Wares mark the oldest or earliest known human habitation in Cholistan which could have begun sometime during the first half of the fourth millennium B.C. They were spread laterally along the greater part of the Hakra River in Cholistan in Bahawalnagar and Bahawalpur districts with their highest concentration southwest of Darawar fort (Fig. 1). The sites are located mostly on stabilized sand dunes and in mud flats which represent the former flood plain. The evidence suggests that during the fourth millennium B.C. the Hakra was a perennial river. It drained most of the water from the Siwalik foothills and flowing into a combined channel, skirted the Thar desert along the borders of the present-day districts of Bikaner and Jaisalmer of Rajasthan State. Among 99 sites of the Hakra Wares, 52 sites represented temporary occupations or camp sites, and 45 were settlements only. Limited industrial or craft related activities is indicated by the presence of kilns at two sites.

Early Harappan Sites

The Early Harappan sites were generally located in the same general

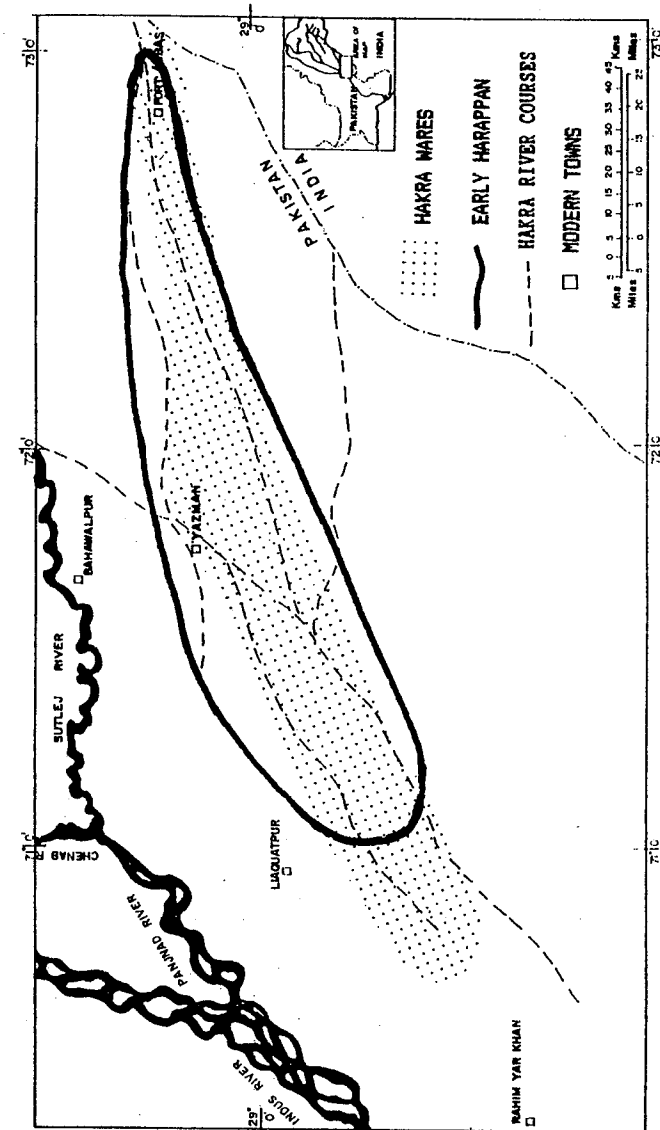


Fig. 1 Areas of the Hakra Wares and the Early Harappan Sites

area where the Hakra Wares sites existed although the density of the Early Harappan settlements is less in the area southwest of Derawar than during Hakra Wares times (Fig.1). It is evident that the Hakra River was still flowing preennially until about 2500 B.C.. The quantity of water available downstream was perhaps less than that the preceding period as suggested by the limited number of the Early Harappan sites there.

During the Early Harappan Period there was a significant change from a nomadic to a sedentary way of life. There are only three Early Harappan camp sites (7.50%) as compared to 52 (52.52%) in the preceding period. The number of settlements with kilns increased to 14 (35%) as compared to only two sites of the same category in the earlier Hakra Period. The settlements or sites marking habitation are 23, constituting 57.5% of the total number. If we combine the multifunctional settlements with exclusively habitation sites, the total comes to 37, out of 40 Early Harappan sites. It is evident that the populations were well settled in Cholistan by the beginning of the Early Harappan Period and the items of daily use had begun to be produced locally at the settlement sites, suggesting craft specialization and by implication, their social stratification.

Mature Harappan Sites

A major and archaeologically dated hydrographic change in Cholistan took place around 2500 B.C. which affected the Early Harappan (Kot Dijian and Sothi related) occupations of the Hakra Valley, necessitating relocation of settlements on new ground (Fig.2). It seems that the changes in the river courses must have affected their subsistence base and forced the populations to abandon, at least partially if not entirely, their settlement areas and agricultural land. Such a situation would have led to a reorganization at the socio-economic and political or administrative levels, and control over economic resources by one class of people over the other. It is important to note that these changes coincide with the climax of the Indus Civilization called the Mature Harappan, and with a very significant increase in craft related activities indicated by the emergence of the areas exclusively earmarked for kilns and mass production of items that are recognized at 79 sites, constituting 45.4% of the total number of 174 Mature Harappan sites. The settlements with kilns were relatively reduced from 35% in the preceding period to nearly 19%. The settlement sites were 50 (28.74%), and the camp sites further dwindled to 5.7% as compared to 7.5% of the Early Harappan Period. Ganweriwala with its 81.5 ha. size was the largest city of the Hakra Valley which incidentally was located at almost equal distance between Harappa and Mohenjo Daro (Mughal 1990b).

Late Harappan Sites

Another major hydrographic change took place about 2100 B.C. when the water supply through a channel from the Sutlej River was reduced to a considerable extent, causing a relocation of the settlements in a restricted area (Fig.2). Once again, the existing settlement pattern on the Hakra was altered, coinciding with changes in the material culture as reflected in the Late Harappan (Cemetery H related) assemblages of the Hakra and its tributaries. The effects of river changes and consequent termination or drastic reduction of water supply on the subsistence economy and social organization were much more disastrous than any other single or multiple causes hitherto proposed by several writers such as invasions, seasonal or unusual floods, over utilization of the land resources, and climatic change. It would be evident that the very decline and eventual disappearance of the Indus Civilization in Cholistan could be directly attributed to the river changes (Mughal 1990c).

The demographic changes as reflected in the number of sites during the Late Harappan Period were also very pronounced. As compared to the Mature Harappan Period, there was an increase in the number of camp sites (26% of the total), indicating an increased emphasis on the utilization of the desert resources. There was also a marked reduction in the number of exclusively industrial sites. The total percentage of purely settlement sites remained constant but an increase of nearly 10% which is over and above that of the preceding period, occurred in the number of multifunctional sites. Among 50 Late Harappan sites, Kudwala (38.1 ha.) dominated the Hakra plain like a metropolitan centre amidst smaller settlements.³

Painted Grey Wares Sites

All the fourteen PGW sites, stretching for 160 km along the northeastern section of the Hakra River bed, were settlements, the largest of which, Satwali, covered an area of 13.7 ha. (Mughal 1984). The location of some sites right in the former river bed (Fig.3) clearly indicates that by the beginning of the first millennium B.C., the water supply had completely ceased in the Hakra River and the desert conditions similar to those of today had set in. The chain of PGW sites continues in the adjoining Indian territory along the Ghaggar River and beyond. Their material contents had no apparent similarity with the Harappan cultural traits.

SETTLEMENT DENSITIES AND SIZE HIERARCHY

An underlying cultural continuity, from the fourth millennium B.C. to the Late Harappan Period, is an outstanding feature of the evidence from Cholistan. The settlement size and frequency of different categories of the

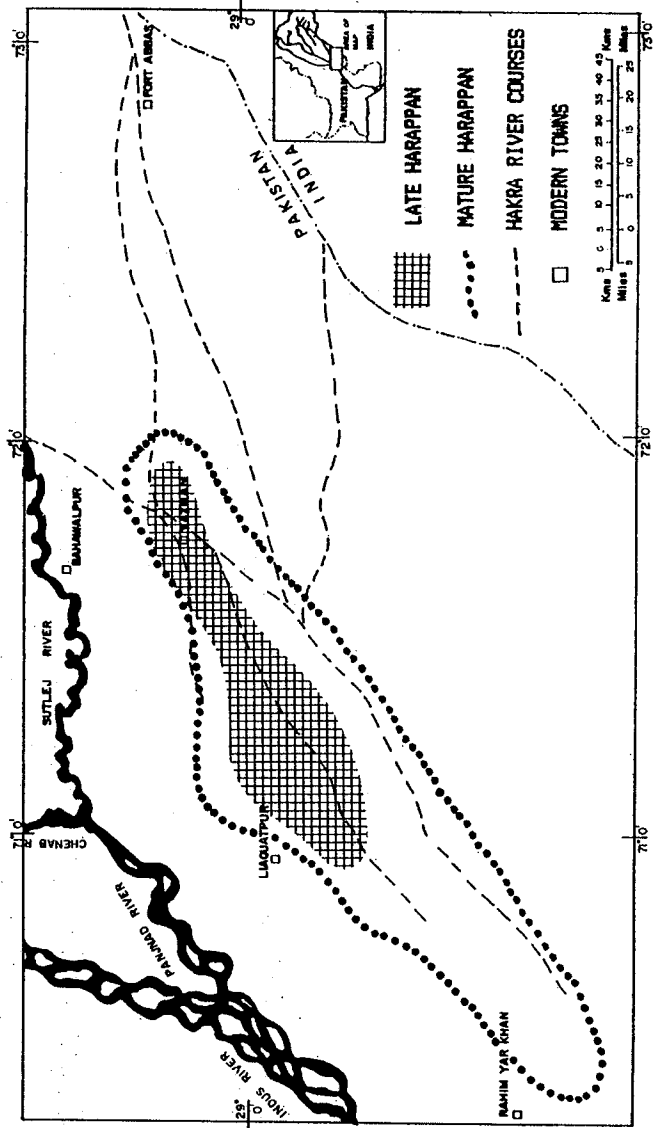


Fig. 2 Areas of the Mature and Late Harappan Sites

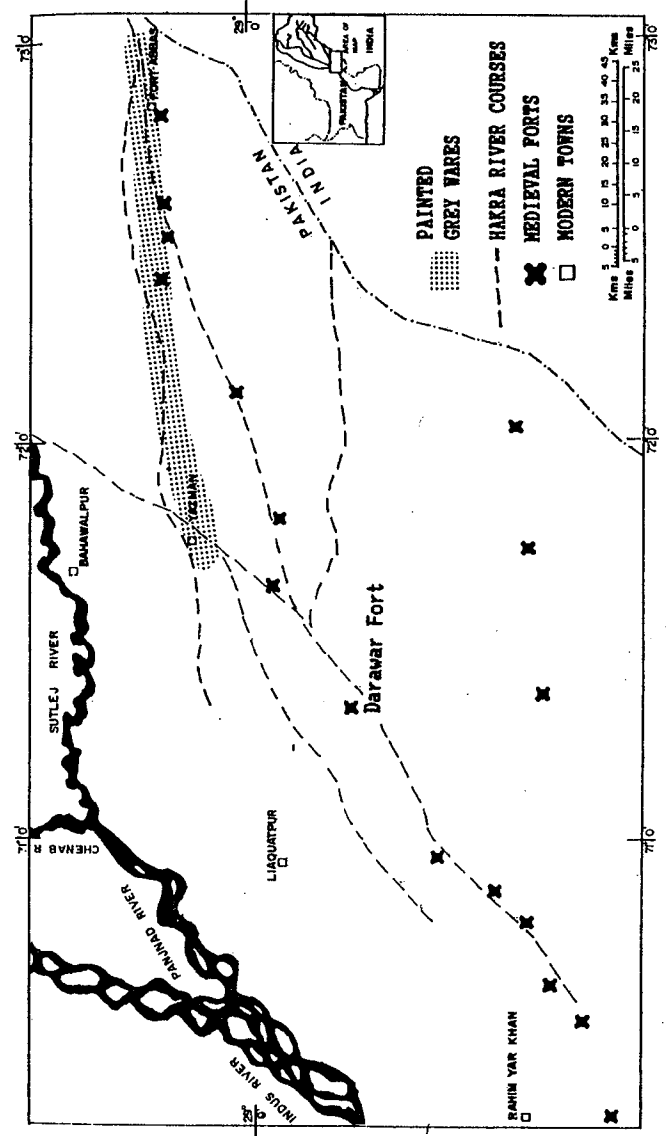


Fig. 3 The Painted Grey Ware Sites and Medieval Forts

sites clearly show hierarchical patterning through time regardless of changes in their locations and cultural materials. In the present discussion, the definitions of the city, town and village are those which were proposed by the present author recently (Mughal 1990d) because no other criterion or definition is available for South Asia. The various definitions of the Near Eastern and Turkmenian settlements are not entirely applicable to the Indus Civilization. In the present context, the sites of more than 30 ha. size, are regarded "cities" while, the small and large "towns" are bracketed between 10.1 and 30 ha. size. The sites up to 10 ha. size are grouped under "villages". For the study of settlement hierarchy, the sizes in hectares are grouped here into six analytical units: 0.1-5 ha.; 5.1-10 ha.; 10.1-20 ha.; 20.1-30 ha.; 30.1-40 ha.; and over 80 ha. (Mughal 1990e: Fig.6 and Table 3).

The total number of settlements and those with some industrial activity consists of 181 sites: Hakra 37; Early Harappan 32; Mature Harappan 73; Late Harappan 26 and PGW 13. The settlement data demonstrates that the sites between 0.1 and 5 ha. in size (or small villages) progressively increased in number and also in the relative percentage of occupied area from the Hakra to Mature Harappan Period. At the beginning of the Late Harappan (Cemetery H related) Period and with PGW, the changes were pronounced.

During the Hakra Period, there were 21 small villages between 0.1-5 ha. in size with a total occupation area of 52 ha. (out of 284.7 ha.). In the Early Harappan Period, the small villages were 19 and their total occupation area was 46.51 ha. (out of 210.1 ha.), making an increase of 21.67% in relative percentage of the total occupation area. During the Mature Harappan Period, a significant increase occurred in the number (44) and their percentage of the occupied area (111.4 ha. out of 447.68 ha.). This increase in settlement sites was well marked in all the three categories of sites in 0.5-5, 5.1-10 and 10.1-20 ha. size. An overall increase in all kinds of sites in number as well as size is evident with an emergence of a very large settlement (Ganweriwala) measuring 81.5 ha. and constituting 18.5% of the total settled area during the Mature Harappan. In the earlier Kot dijian and Hakra Periods, there was no site within the size range of 30 and 40 ha. The largest Early Harappan site in Cholistan (so far known in the Greater Indus Valley) is Gamanwala, measuring 27.3 ha. and the largest known Hakra settlement is Lathwala II (26.3 ha.) both falling within 20.1-30 ha. range or large towns. The settlements falling within 20.1-30 ha. size range did not emerge in Cholistan after the Early Harappan Period. It

seems that the four-tiered settlement hierarchy that began with the Hakra Wares Period persisted through the Mature and Late Harappan Periods. The evidence further shows that, at least in Cholistan, there was no hierarchical patterning of settlements in the PGW Period. A progressive increase in number is also evident in the settlement size and numbers of 5.1 to 10 ha. size from the Hakra to the Mature Harappan Period. Their number increased from five in the Hakra Period to eight in Early Harappan going up to 20 in the Mature Harappan.

During the Hakra Period, seven towns ranged between 10.1 and 20 ha. in size, occupying 109 ha. settled area (out of 284.7 ha.) in that period. The settlements covering 20.1-30 ha. area were four, occupying a total of 87.6 ha. The total occupied area during the Hakra Period was 284.7 ha. for 37 sites of all sizes. It is pointed out that in the succeeding period, there was a reduction in the total occupied area of 32 Early Harappan sites, all of which covered 210.1 ha.

The Mature Harappan small towns of the size between 10.1 and 20 ha. were eight in number which covered 25.37% area of the total 447.18 ha. These small towns, in fact, demonstrate an increase over those of the Early Harappan mostly in number but slightly in area as well. The hierarchical ordering of settlements was further sharpened in the Mature Harappan by the one city of over 80 ha. size range.

The settlement data pertaining to the Late Harappan in Cholistan clearly demonstrates a major change in the settlement size and number. The four-tiered hierarchy of the Mature Harappan times persisted, though the size of the largest settlement was 38.1 ha., much less than Ganweriwala (81.5 ha.) of the Mature Harappan. The largest site, Kudwala represented 17.6% of the total occupied area. The next or second largest site was Shahiwala (20 ha.), and four out of six settlements in 10.1-20 ha. size were between 15.8 and 20 ha.. The group of sites between 10.1-20 ha. or towns represented 45.5% of the total occupied area. The villages in 0.1-5 ha. and 5.1-10 ha. size range significantly decreased in number and in their occupation area.

The PGW occupation on the Hakra River in Cholistan was restricted to a relatively small area. Twelve settlements were up to 5 ha. in size covering 22.1 ha. or 61.73% of the total occupied area, and only one site was 13.7 ha. in size, singly representing 38.26% or more than half of the total area occupied by all 12 sites. No hierarchy of settlements is evident as there was also no cultural or chronological continuity in Cholistan of the Indus Civilization with the PGW Period.

CONCLUSIONS

The foregoing analysis of data from Cholistan clearly demonstrates that the four-tiered hierarchy of settlements had already come into existence by the fourth millennium B.C., identified in the central Indus Valley with the Hakra Period. Similar four-tiered hierarchical pattern continued during the Early Harappan Period but villages increased in number. This increase in villages corresponded to a decrease in the total occupied area of the towns. The Mature Harappan Period was marked by a sharp increase in the number and relative percentage of settlement area of the villages and towns, and by the emergence of at least one principal centre. In the Late Harappan Period, the four-tiered pattern continued but on a reduced scale. The principal site then covered 38.1 ha. area and there was no site between 20.1 and 30 ha. size. In brief, the settlement hierarchy is so well pronounced in Cholistan not only during the Early, Mature and Late Harappan Periods, but also in the earliest known cultural assemblage of the Hakra Wares. The material culture should also demonstrate a link between the Hakra and the (Kot Diji related) Early Harappan Periods. If we combine the first two categories of 0.1-5 ha. and 5.1-10 ha. size settlements, the resulting picture will show three-tiered (instead of four) hierarchical pattern of settlements throughout from the fourth to the second millennium B.C.

In the end, it may be emphasized that the hydrographic factors profoundly influenced the life history of the Indus Civilization and, indeed, were the major cause of its decline in Cholistan. The causes of change in the material culture in the Early, Mature and Late Harappan times can be best understood and explained in the context of changes in the Hakra River courses. The consequences of such river changes are best demonstrated in Cholistan by the dramatic evidence of shifting settlements grid associated with each major change in the river course. The consequences of frequent adjustments of the populations to the changing environment, forcing them to carry out necessary structural reorganization at the social, economic, political and other levels in response to the challenging situation for survival, are vividly reflected in the material culture and variations in settlement densities and size hierarchies. The existence of some settlements in the Medieval Period such as Rang Mahal (Rydh 1959), was dependent on the availability of a permanent supply of water from the wells and water tanks or *tobas* like the present-day settlements in Cholistan and elsewhere in the Thar desert.

NOTES

1. This paper is partly based on a section of research work carried out during 1988-89 at the University of Pennsylvania. The relevant statistics on the settlements included in this paper are derived from a long article under publication (Mughal 1990d)
2. It corrects the counts given in the area and percentage columns of the Late Harappan as published in Mughal 1990c: 193, Table 3. The occupied area of Kudwala comes to 17.05% of the total settled area of 223.33 ha. during the Late Harappan. Accordingly, the percentages of the settlement areas of the other sites in 0.1-5, 5.1-10 and 10.1-20 ha. size categories, will stand corrected as 12.80%, 22.80% and 44.01% respectively.

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