Was the Rann of Kachchh navigable during the Harappan times (Mid-Holocene)? An archaeological perspective

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The Kachchh region, presently, is one of the difficult areas in the Indian subcontinent for human settlement due to harsh climate, scanty rainfall and hence no scope for agriculture production. However, the region was probably densely populated in the past, as can be inferred from archaeological studies around the Rann. Several sites of the Harappan period (Dholavira, Juni Kuran, Surkotada, Shikarpur, etc.) urban in nature have been located within the borders of Rann. Thus a pertinent question arises as to why such large settlements were established in this area? Presently, the Rann of Kachchh is a storehouse of a thick layer of salt between Kori Creek in the west and Nagarparkar in the east. There are several geological studies indicating that different environmental conditions prevailed here in the past. The area of Rann probably could have served as a navigational channel/water body, which facilitated safe harbours for overseas trade with the Gulf countries and internal trade through riverine route which prevailed in the recent past.

Keywords: Ancient ports, Harappan sites, navigation, palaeoenvironment, Rann of Kachchh.

MARITIME province of highly sophisticated Indus civilization, alternatively known as Harappan civilization, was spread over a large part of Kachchh and Saurashtra of the present day Gujarat state[1]. Harappan settlements in Saurashtra have some significant traits and differ in certain aspects, specially in architecture and pottery from sites in the northern parts of the domain. Harappan settlements in Kachchh have significant similarity with sites found in Sindh. Therefore some scholars used different terminology for Harappan settlements in Gujarat, namely Sindhi or classical and Sorath Harappan[2].

Kachchh, which has been variously spelt in the past as Cutch, Kutch or Kachchh, is the westernmost part of the Indian territory which houses one of the most enigmatic geological features called the Rann of Kachchh. Perhaps the word 'Rann' is derived from Rigvedic '*Irina*' and Ptolemy refer '*Eirinon*'[3]. The Rann of Kachchh is a vast marshy salt plain, rising barely above the sea level. It extends about 300 km from east to west and at a few places about 150 km from north to south. It is divided by the highland of Kachchh into two parts: the Great Rann (about 18000 sq. km) in the north and the Little Rann (about 5000 sq. km) in the southeast. The Great Rann connects with the Arabian Sea through Kori Creek in the west and the Little Rann is connected with the Gulf of Kachchh in the southwest. During monsoon, major part of the Rann remains under water and from November to May the Rann often remains dry.

Topographically, the Great Rann is a bowl-shaped depression, the prominent depressions generally occurring adjacent to Pachchham, Khadir and Bela hill massifs. The eastern edge of this region merges into the Luni drainage area. There is an elaborate description of the Rann of Kachchh in the Periplus of the Erythraean Sea[4], which states 'Beyond the river Sinthus there is another gulf, not navigable, running in towards the north; it is called Eirinon; its parts are called separately, the small gulf and the great; in both parts the water is shallow, with shifting sandbanks occurring continually and a great way from shore; so that very often when the shore is not even in sight, ships run aground, and if they attempt to hold their course they are wrecked.'

There are three prominent hypotheses regarding the palaeo-morphological condition, especially during the Harappan times, namely: (a) formerly an arm of sea which had been raised due to a series of tectonic activities[5–9], (b) similar conditions are prevailing at least since the 3rd millennium BC (ref. 10) and (c) the Rann as a delta region of the Indus and other rivers and present change in morphology is due to tectonic disturbance of 1819 (ref. 11).

In this article we study the possible reasons for the establishment of several mature Harappan sites in the Kachchh peninsula, particularly along the Rann of

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Kachchh. Was the Rann a navigable waterbody earlier which was approachable through sea/river route from Sindh region is one of the prominent questions that needs a logical answer. We also review the archaeological and geological studies which have been undertaken earlier. Geological studies have been cited significantly to understand palaeo-environmental conditions. Digital Elevation Model (DEM) for areas in and around the Gulf of Kachchh is used to find the possibility of any connectivity in the land area between the Gulf of Kachchh and the Gulf of Cambay in the past. DEM is a raster image consisting of regularly spaced height values. DEM was generated using the ARCGIS software and variations of the topography were colour-coded. Maps were generated with the normal current DEM values, 5 m reduced than the current DEM, and the areas within 0–20 m were also extracted.

Harappan sites in Kachchh and the surrounding areas

In the early seventies, extensive explorations in the Kachchh area revealed a large number of sites of the mature Harappan phase and many of them have been excavated extensively; all important features are present at each site. A large number of Harappan settlements have been found in Kachchh (Figure 1) and majority of them belong to the early phase and about one-third represents the mature Harappan late phase[12–14]. Only a handful of sites of the early phase continue into the late phase and the remaining are new settlements of the late Harappan times[3].

The distribution of Harappan sites (Figure 1) in Kachchh demonstrates an interesting trend as majority of the sites are observed along the east-west central axis, as well as in the northeastern part of Kachchh. Absence of early mature phase sites along the coastline of the Arabian Sea and their presence along the coast of the Rann is indeed interesting. For the construction of buildings at these sites, local stone has been used on a large scale. Brief information about a few excavated sites is as follows.

Dholavira situated on the Kadir Bet is the biggest Harappan site discovered so far in the Kachchh region. It measures over 100 hectares[15]. The entire town was partitioned into three divisions, namely citadel, middle town and lower town. Identification of two stadiums also indicates that there was adequate provision for sports and community entertainment during the Harappan times. Water harvesting is another important feature of this site. Being in the island, the Harappan people may have been facing acute water problem. They dug out about 10 tanks at different places of habitation to meet water requirement during the summer season. One of the most perfectly planned cities has many distinguishable features; however, the description of those aspects is beyond the scope of this article. The site has the longest cultural sequence of the protohistoric period beginning from Pre-Harappan period (3000 BC) to the late phase of the late Harappan period. The site also witnessed at least three major earthquakes around 2900, 2700 and 2100 BC (ref. 16).

Surkotada (locality 11 in Figure 1) is situated close to the village Sanava near Adesar[10] about 5 km from the channel connecting the Great Rann with the Little Rann of Kachchh. Though the site is small, it is strongly fortified. Most of the construction had been carried out with locally available stones. All features related to mature Harappan phase are present here and the site has been described as garrison[10].

Juni Kuran (locality 3, Figure 1) formerly known as Kotara is located on the bank of the Great Rann in Pachchham island[17]. The planning of the town is similar to that of Dholavira. It has a fortified citadel and a lower town with a stadium in between.

Shikarpur (locality 10, Figure 1) is located near the northern coast of Little Rann of Kachchh. It has not been excavated on large scale; however, height of the mound indicates a significant deposit.

Bagasra (locality 52, Figure 1). Recently, archaeologists from M.S. University excavated this site on the southern coast of the Little Rann of Kachchh. It is a small fortified site[18] situated about 1 km from the high waterline. The site was an important shell-working centre as a large number of waste and finished shell product have been recovered.

East of the Rann. On the east of the Rann, a number of sites have been discovered on the banks of Banas river. Excavation has been carried out at Nagwada, a shell-working centre[19]. A few other sites, namely Jhekda, Benap, Vadgam and Ratanpura have been excavated and their participation in maritime activities has been recorded.

North of the Rann. A few Harappan sites have been mapped by Possehl[20], north of the Rann, these are Kot Kori, Koonj Sor and Korohio Pir (locality 57–59, Figure 1).

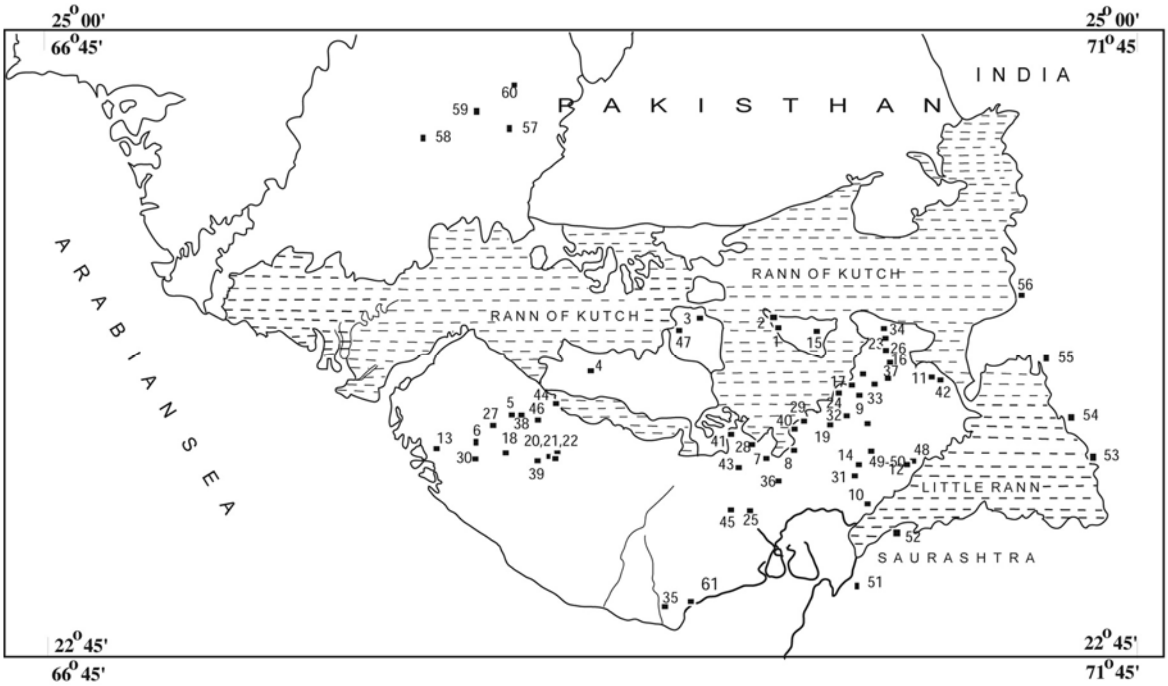
In addition to the above, many other sites situated along the Rann of Kachchh suggest that considerable population lived in the Kachchh region during the mid-third millennium BC.

Discussion

There has been serious debate over the existence of several Harappan sites in the Kachchh Peninsula. The British explorers of the 19th century made several observations regarding the morphological change of the Rann of Kachchh. They have recorded several traditions regarding the change in morphology of the region.

Harappan migration to Kachchh and Saurashtra

The excavations at Lothal and Rangpur in Saurashtra and non-availability of data on the Harappan settlements in



1. Dholavira
2. Saran
3. Juni Kuran
4. Luna
5. Desalpur
6. Khirasara
7 Pirwada Khetar
8 Jhangar
9. Pabumath
10 Shikarpur
11. Surkotada
12. Babarkot
13. Bedi
14. Chitrod
15. Gadhada Khadir
16. Gedi
17. Jesada
18. Kalyanpur
19. Kanthakot
20-22 Kotada Bhadli I, II, III
23. Kotada
24. Lakhapar
25. Meghpar
26 Moruo/Jatavada
27. Narapa/Gharani
28. Nenu-ni-Dhar/Sumrasar
29. Ner
30. Netra
31 Rampara
32. Ramvav
33. Rapar
34 Rasaji Gadhada/Lodrani
35. Samaghogha
36. Sevakiya/Bhachau
37. Selari
38. Vada /Vigodi
39. Madhapar
40. Manafara
41. Lodai
42. Lakhagadh
43. Chandani
44. Chhernani
45. Kadoi
46. Jetavira
47. Jhangar (Khavada)
48. Kanmer
49-50. Lakhasar I, II
51. Kuntasi
52. Bagasra
53. Nagwada
54. Vadgam
55. Jhekada
56. Benop
57. Kot Kori
58. Koonj Sor
59. Korohio Pir
60. Markhan
61. Navinal

Figure 1. Major Harappan sites around the Rann of Kachchh.

Kachchh in the sixties led to the belief that the Harappans might have used sea to land route in Saurashtra region[21]. However, subsequent findings from excavation at Surkotada and the discovery of several Harappan sites in Kachchh question this hypothesis. Joshi[10], after the excavations at Surkotada and discovery of other sites in Kachchh, suggested that 'the most popular land route preferred by the Harappan seems to be one from Gharo Bhiro in southeastern Sind, Allahdino to Kotara (Juni Kuran) and then on to Kotadi (Dholavira) and to the various sites in the Rapar Taluka of Kutch…'. This hypothesis was based on the fact that the present environmental conditions prevailed in the past as well. However, a report on pollen of Surkotada site, indicates that a different environmental condition prevailed in the region during the Harappan times[22]. Merh[23] remarked that the Indus Valley people navigated to Kachchh along the major river and to Saurashtra through the shallow connecting sea.

Archaeological studies in Kachchh clearly demonstrated the existence of a prosperous dynamic society during the Harappan times. Even though the Harappan civilization is supposed to be agrarian, Kachchh did not offer a good cultivable land for an advanced society like the Harappans. Thus the colonization of Kachchh by the Harappans could have been reasons for other than agrarian. Bisht[24] observed 'Kutch does not fulfill requisite qualifications to be an advance agrarian state. It becomes, therefore, all the more imperative to comprehend the palaeoclimate as well as ergonomic mechanism so that the palaeoenvironmental conditions and land–man relationship existing in the Indus times are understood better.' Regarding the agricultural product during the early 19th century, Macmurdo[25] mentions 'Cutch does not produce (grain) one half sufficient for its consumption. Grains of all kind imported, some from Hullar or the Peninsula Guzarat and others from Malabar or from Sind.'

Figure 2. Proposed map of Rann of Kachchh during the 3rd millennium BC.

Thus it is clear that Kachchh has never been an attraction for the agrarian society; instead the Harappans have been considered as great mariners and successful businessmen. The recent study on the source of various kinds of stones and metal by Law[26], indicated that Gujarat and Kachchh regions have been the major source of limestone, agate, lead, etc. The large-sized limestone rings discovered at Harappa and many other sites might have been transported from Khadir or Pachchham islands in the Rann of Kachchh. At times the weight of these stones is about 100 kg; thus there is a possibility that the sea and riverine route might have been easier for such transportation, which could have been approached by crossing the Rann as former sea.

Was Rann navigable during the Harappan time?

In Kachchh majority of Harappan settlements were fortified and had well-laid habitation plan. Dholavira, one of the biggest Harappan sites of the Indian subcontinent, has some extraordinary features such as stadium, water-harvesting system, etc. which indicates that it was an important centre of human habitation. As stated earlier Harappans were an agrarian society. However, the same was not the case with the Harappans of Kachchh, as this region does not and did not offer good cultivable land. If it was not an agricultural attraction, then what other factors attracted Harappans to settle in the Kachchh region? Interestingly, majority of the Harappan sites are on the southern border of the Great Rann and all around the Little Rann. They are almost absent on the coast of the Gulf of Kachchh. If one compares the location of the present major towns such as Gandhidham, Mandovi and Bhuj, they are closer to the Gulf of Kachchh than the Rann of Kachchh. The reason is simple; the movement of goods is easier through sea because a large number of ports existed along the Gulf of Kachchh. Thus, the locations of Harappan towns along the Rann of Kachchh indicate a different morphological condition in the past and perhaps the Rann was navigable in the 3rd millennium BC. If the historical factors are taken into consideration, then the Rann of Kachchh was a shallow waterbody during the early centuries of the Christian era[4] and even until late medieval period[27].

Gupta[28] has made a detailed study of sedimentation rate in the Little Rann of Kachchh and Nal Lake, and suggested that the average rate of sedimentation in the Little Rann during Holocene has been about 2 mm/yr, ranging from 1.5 to 3 mm/yr at different locations. There is absence of any evidence for the tectonic instability of the region during the Holocene, which implies, that even as late as 2000 years ago, the Little Rann was about 4 m deep and thus was inundated throughout the year. Similar studies of the Great Rann of Kachchh near Khadir Bet indicate an annual rate of sedimentation of 1.22 mm which continued till 500 yrs BP (ref. 29).

Roy and Merh[9] suggest three factors for the recent drastic change in morphology of the Rann of Kachchh. They are (i) Palaeoclimatic changes over Kachchh/Rajasthan, which affected the fluvial/fluvio-marine cycle; (ii) Eustatic changes and (iii) Recent tectonic activity. Interestingly, Merh[29] has mentioned that the Rann of

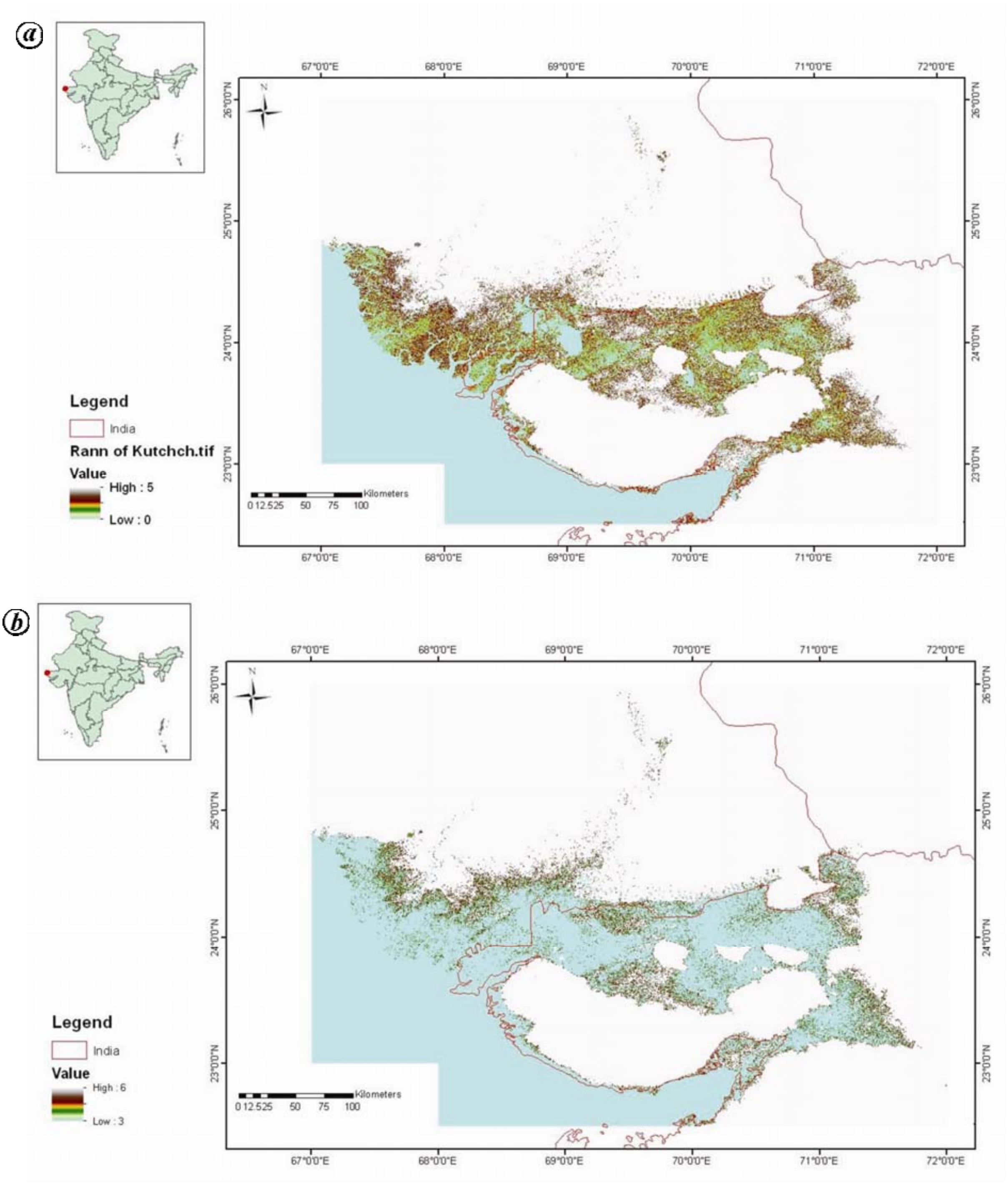


Figure 3. ***a***, The present topography. ***b***, Topographical features with 3 m rise in sea level.

Kachchh was connected to the Gulf of Khambhat via Little Rann and Nal-Bhal region (that separates Saurashtra from main land of Gujarat). Thus, both the Ranns, Gulf of Kachchh and Gulf of Khambhat were interconnected, which facilitated navigation in the entire Harappan domain of Gujarat.

Morphological changes in lower Sind have been so significant that the River Indus has been shifted several kilometres westward[30], which affected the Rann of Kachchh during historical times. Earlier study of coastal Harappan sites along the Saurashtra region indicated significant change in coastline in the Gulf of Khambhat region[31]. There are two important factors responsible for morphological changes in the Rann of Kachchh – tectonic activity and sea-level fluctuation.

Kachchh is well known as a seismically highly active zone and a number of severe earthquakes have been recorded recently. From archaeological investigation, at least three earthquakes have been recorded in the Harappan times[16]. The final earthquake led to the abandonment of the early Harappan settlement sometime around 2100 BC and it was reoccupied after a few decades by the late Harappans. However, there are very few late Harappan sites noticed in Kachchh, which also indicates that people might have shifted towards Saurashtra region (comparatively safer for earthquakes) and perhaps because of this a large number of late Harappan settlements have been observed in Saurashtra region.

The next factor is the sea-level fluctuation. At the onset of the Holocene the sea level rose globally and settled at a higher level than the present level around 6000 yrs BP (refs 32 and 33). Earlier archaeological studies have indicated a higher sea level during the Harappan times (Mid-Holocene). Many sites considered to be ports are now lying in the hinterland[23,31] and a large number of sites are situated around the Rann of Kachchh; thus indicating that the sea level was higher during the Harappan times. Therefore, seismic activities as well as sea-level fluctuation played a vital role in raising the floor of the Rann of Kachchh which developed into a barren land. Marine erosional features are found along the base of the north-facing escarpments of the islands of the Rann of Kachchh, and they indicate higher sea level and also uplifting of the floor of the Rann. These events occurred during Mid-Holocene to Late Holocene[34,35].

Sivewright[36] had prepared a map based on the historical description provided by an Arab historian during the Arab invasion of Sind in AD 712 which suggests that the mouth of the Gulf was as far as Debal (presently it is several kilometres away from the shoreline in the hinterland). This observation indicates that the Rann was an extended arm of the sea and must have been navigable in the past. Based on the locations of Harappan port sites, it is presumed that the northern boundary of the Rann as a Gulf extended by several kilometres inland (Figure 2).

The study and analysis of digital elevation map suggest that in case of rise in sea level of about 3 m, both Ranns have a water depth of 3–5 m and both Ranns form part of the Arabian Sea (Figure 3). These areas are highly sensitive to tectonic activities and the concern of rise and depression of land is suspected in the past. Based on archaeological evidence, it may be postulated that both Ranns were navigable in the past. DEM analysis also supports the same.

Conclusions

Presently, the least populated region of the country was moderately populated during the 3rd millennium BC by the Harappans. Though Harappan society was primarily an agrarian society, the Harappan settlements in Kachchh may have been a trading community. The movement of these people must have been a strategic plan under the expansion of Harappan domain in early stages of the civilization to occupy the coastal areas of Kachchh for internal as well as overseas trade, and also for the exploitation of the marine resources, closest available around the Gujarat coast. River Indus must have served as the waterway between Sind and Kachchh, which may be a direct and easier route to reach Juni Kuran or Dholavira on Pachchham and Khadir Island in the Rann of Kachchh respectively. Kot Kori, Koonj Sor and Korohio Pir would have served as ports in the northern coast of the Rann of Kachchh. Thus, the environmental as well as morphological conditions must have been different than those existing at present. There are several evidences of change in morphological conditions in lower Sind area, which was responsible for the westward shifting of the River Indus. These evidences point towards the Rann being an extended Gulf and must have been navigable at least up to the early centuries of the Christian era, the Little Rann of Kachchh was navigable even as late as 16th century AD.

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