

CHAPTER-2

ENVIRONMENTAL OUTLINES OF THE LITTLE RANN OF KUTCH

INTRODUCTION

Kutch, also spelt as Kachchh, Kachh, Cutch, has derived its name from the resemblance of its geographical characteristics and topographical features to the 'tortoise' called as 'Kachba' in Gujarati. The Rann of Kutch is a saline mudflat in the west-central India and southern Pakistan. The Great Ranns covers an area of 18000 sq. Km. and lies almost entirely within Gujarat state, India, along the boarder with Pakistan. The Little Rann of Kutch extends north east from the Gulf of Kutch and occupies an area of about 5100 sq. Km. The Rann of Kutch has been closed off by centuries of silting. During the time of Alexander the Great it was navigable lake, it is also evident from the remnant of the port structure of 13th century lying in the Jhinjwada village, but it is now an extensive mudflat which gets inundated during monsoon season. There are some 23 islands in the midst of the Little Rann of Kutch. The area experiences extreme type of climatic conditions.

The Little Rann of Kutch acquires a triangular shape with its one apex on the northern side and base along its southern boundary. The western most part of the Little Rann of Kutch acts as a mouth along the Gulf of Kutch, through which marine water is drained towards the inland areas of the Rann. The entire Rann landscape is of recent origin formed after the deposition of sediments brought from the adjacent highland area. The Rann is characterized by the availability of heavy dark brown-black soil owing to the availability of basaltic landscape in its catchment area.

2.1 GEOLOGICAL SETTING OF THE LITTLE RANN OF KUTCH

The Rann of Kutch is one of the most distinctive geological formation & is comprises of peculiar geomorphic entity of the Indian sub-continent. The geological history of the Little Rann of Kutch is no different from that of the Great Rann of Kutch. At macro level both shows homogeneity in terms of its geology, geomorphology, ecology, climatic conditions etc., however, at micro-level it shows considerable diversities.

This monotonously saline flat surface with annual inundation, have executed the Rann an enigmatic piece of terrain. (Lyell, 1855) has portrayed the Rann as a singularly flat region which is neither land nor sea which dries up during some part of a year and again inundated by saline water from the sea side and fresh water from the adjoining land area during monsoon. The Rann of Kutch was a gulf of the sea with surrounding coastal towns (Frere, 1870). Wynne (1872) refuted the idea that the Rann is an uplifted seafloor. He believed that seafloor can not possess such a monotonous ground character as that of Rann. In fact he advocated that entire plain was a delta of the Indus. However, the present condition is the result of recent upheavals which led to the west ward migration of channels of Indus. Oldham (1893) and Wadia (1926) on the other hand shares the different view that is the Rann is a tectonic basin and is now alleviated by several small rivers which are pouring water from the north-east, east and south.

In the words of Wadia (1926), "Rann, a tract of the Indo-Gangetic depression, which owes its present condition to the geological process of the Pleistocene age...., once an inlet of the Arabian sea, which has now

been silted up by the enormous volume of detrious poured into it by small rivers discharging into it from the east, north and north-east"⁶.

"The space where this sediment collected was a bay about twenty three centuries ago. The energy to bring the sediment was supplied by the Indus River and the energy to smooth the surface was provided by the frequent earthquakes, some of which have been severe. No need has been found to call upon extra-ordinary processes. The Rann of Cutch is extraordinary however because it has been observed to change from marine bay to alluvial plain in a Geological short time, and without any complications from Pleistocene changes in sea level" (Platt, 1962)⁷.

Glennie (1970) was in the opinion that the surface of Rann is at or slightly above sea level. During three months of the south-west monsoon, storm tides, aided by the wind, force water from the Arabian Sea over the flat surface of the Ranns. Rainfall is fairly low, so that as the water recede and evaporate, they leave behind a crust of halite and gypsum crystals which grow in the clay and sands. The few rivers which flow into the eastern ends of the Ranns carry only limited fresh water and sediment during the monsoon. For the rest of the year they are dry. The result is that an area of about 30,000 sq. Km. is subjected to annual flooding with the succeeding formation of evaporites.

"Tectonically the Kutch region is controlled by numerous E-W faults which have led to the formation of hill massifs of Kutch mainland, Pachham, Khadir, Bela and Chorar as "horst" or "uplifts", and the low lying tracts of the Great Rann and the Banni plain as the site of "grabbons" or

⁶ Wadia, D.N., (1926), "Geology of India". Macmillan London, P-384

⁷ Platt, I.B., (1962), "The Rann of Cutch". Journal Sed. Petrol. Vol-32 (1), Pp-92-98.

“residual depressions” (Biswas and Deshpande,1970)⁸. Similarly the Wagad can be equated with the uplifts while the Little Rann of Kutch with that of residual depression.

According to Srivastava (1971), the complete Kutch has witnessed the block movement along WNW-ESE trending fault, which resulted into the formation of number of horsts and half grabbens. “The islands example, Pachham, Khadir, Bela and the Kutch mainland form the horsts while the depression area such as Banni plain, Great Rann and the Little Rann of Kutch being the grabben areas”⁹. The depression areas that is, the two Rann and the plain got alleviated gradually along with the little upliftment gradually.

“This fascinating landscape is the result of the complicated interaction of sea level changes, climatic fluctuation and tectonic movement during last 10,000 years. Seismically, the area is very sensitive as it is frequently visited by earthquake”, (Mallik, 1999)¹⁰. Such type of active sismicity in the region may be attributed to its nearness to the junction of the geo-synclinal belt of Sindh-Baluchistan and the western continental margin and also because of the trio-junction which is formed by the Indian, Arabian and African plates. The Kutch has been visited by earthquake through its geological history. In the near historical past two major earthquake have been witnessed viz. 1819 Allah Bund

⁸ Biswas, S.K. and Deshpande, S.V.,(1970)., “Geological and Tectonic Maps of Kutch”. Bulletin ONGC, Vol-7 (2), Pp-115-123.

⁹ Srivastava , P. K., (1971), “Recent Sediments of the Ranns of Kutch”. Journal, Geological Society of India, vol-12 (4), Pp- 392-395.

¹⁰ Mallik, J.N., Merh, S.S. and Sridhar, V. (1999) “Paleo-delta complex of Vedic Sarasvati and other ancient rivers of north-western India”. Members Geological society of India, no.42, pp.163-174.

Earthquake along the northern margin of the Great Rann and the 2001 Bhuj earthquake that was located along the southern margin of the Great Rann of Kutch.

Both Rann has witnessed & experienced significant geomorphic changes because of the tectonic movements and sea level changes during Holocene. "A large part of Rann was a marine gulf and that is generally emerged out of the sea in the course of the last 2500 years" (Merh, 2001)¹¹. Marine conditions in the Ranns continued to prevail even during historical times (Mac Murdo, 1824; Wadia, 1975). Gradually recession of the sea changed the area to an estuary. In view of Mallik (1999), till recent, a few thousand year back, it was a delta complex, which received water & sediments of a number of Himalayan Rivers. "Rivers viz. Sindhu (Indus), Sarasvati and Shatadru (Proto-Sutluj) were flowing across the northwestern plain of India, emptied their water into a shallow sea that now marks the site of Rann of kuchchh"¹². All along the banks and near the mouth of these paleo-rivers were located important towns of Indus valley (Harappan) civilization, which is now perceived to be destroyed by the tectonic & seismic upheavals in the past.

Over a vast space of the now desert country, east of the Indus, traces of ancient river beds testify to the gradual desiccation of a once fertile region; and throughout the deltaic flats of the Indus may still be seen old channels which once conducted its water to the Rann of Kutch, giving life and prosperity to the past cities of the delta, which have left no

¹¹ Merh, S.S. (2001), "The Great Rann Of Kuchchh: perception of a field geologist", updated version of the lecture delivered on 21st Nov, 2001 at national Geophysical Research Institute, Hyderabad, on the occasion of the presentation of D. N. Wadia Medal (2001) awarded by INSA to the author.

¹² Ibid.

living records of the countless generations that once inhabited them. Rann of Kutch, originally an extension of the Arabian Sea has been closed off by centuries of silting. As per the record in the Bombay Gazetteer, during the time of Alexander the Great, who invaded India during 325-320 B.C., the Rann of Kutch was a navigable lake.

The relationship between a tectonic event and climatic change and there by intensification of processes as a result of the climatic change shows that tectonic activity causes erratic extreme events not only directly in the areas of tectonic activity but also else where as is reflected by the works of Rampino (1984), La Marche & Hirschboeck (1984).

This Quaternary terrain of the Kutch has remained isolated & received little attention in the past, perhaps because of its hostile environment & inaccessibility to the region. For the first time, the detailed investigation of the Rann, especially its inundation phenomenon was done by The Maharaja Sayajirao University Of Baroda, spear headed by Prof. Merh, S. S., Department of Geology in the year 1970. The study reveals poor and discontinuous Quaternary records. However, following sequential stratigraphy has been suggested by Merh (1995)¹³.

Sediments of the Little and Great Rann; Raised mud flats along the Kachchh coast.	Holocene.
Dual accumulation of Miliolite.	Upper to middle Pleistocene.
Conglomerates and grit of the upper part of Kankawati series.	(?) Lower Pleistocene.

¹³ Merh, S.S. (1995), "Geology of Gujarat". Geological Society of India, Bangalore, pp.156-161.

The Holocene deposits (including Recent & Sub-Recent) of Kutch has been categorized viz; the sediments of the Rann and Coastal mud-flats and sandy beaches.

As per the fundamental principle of modern geology which is also known as " Principle of Uniformitarianism"¹⁴, postulated by renowned Scottish geologist James Hutton, it is necessary to evaluate the present day process to understand the geological evolution of the Rann as "Present is the key to past"¹⁵. "It is presumed that all along the Holocene epoch, identical conditions have prevailed but, may be in varying intensity"¹⁶.

Thus it is apparent from the available literature that the Little Ranns of Kutch is unquestionably a segment of the shallow continental shelf. This shallow marine gulf gradually raised or, because of the regression of sea water this shallow and monotonously flat relief attained the present height, slightly above the sea level or tidal range of Arabian sea to form the Rann sometime during the last two thousand years only and the same is evident by the presence of calcareous beds several meters above the present sea level and the archaeological and historical evidences as well.

The Rann acts as a wet land & dry land in different periods of the year. Annually, during monsoon season the Rann regains its continuity with the Gulf of Kutch. The Rann get partially flooded not only by the surface runoff from the surrounding highlands & ephemeral rivers but also through

¹⁴ William D. Thornbury (1969), "Principles of Geomorphology" (2nd Edition). John Wiley and Sons Inc. p-16

¹⁵ Ibid

¹⁶ Merh, S.S. (1995), "Geology of Gujarat". Geological Society of India, Bangalore, pp.156-161.

the marine water from the Arabian sea which ingress through the gulf & creeks driven by storm tides. During this period lots of sediments also gets deposited in the flooded Rann.

All ephemeral rivers viz.; Rupen, Bambhan, Malwan, Kankawati, Saraswati etc. pouring water in the Little Rann of Kutch in particular carry lots of sediments with them. Also, the marine tidal water which enters the Rann is laden with lots of sediments brought from the Indus deltaic region. Both sediments from different sources are deposited in the Rann in a similar fashion where coarser sediments are deposited all along the periphery of the Rann while finer sediments are carried further and spread over the interior part of flooded areas. Rann remains shallow brackish water lake for three to four months in a year.

During summer the same Rann acts differently. The area becomes dry & barren with very high temperature resulting into the drying up of brackish water lake leaving behind the sediments in the form of mud flats & thus, the mud flats are gradually built every year.

2.2 GEOGRAPHICAL SETTING OF THE LITTLE RANN OF KUTCH

PHYSIOGRAPHY OF THE REGION:

The Kutch is a unique and unusual unit of assemblage of geomorphic terrain of the Indian sub continent. It is the north-western most district of Gujarat state and forms an independent geological and geomorphic unit. The geographical terrain of Kutch can be safely classified into four zones from north to south.

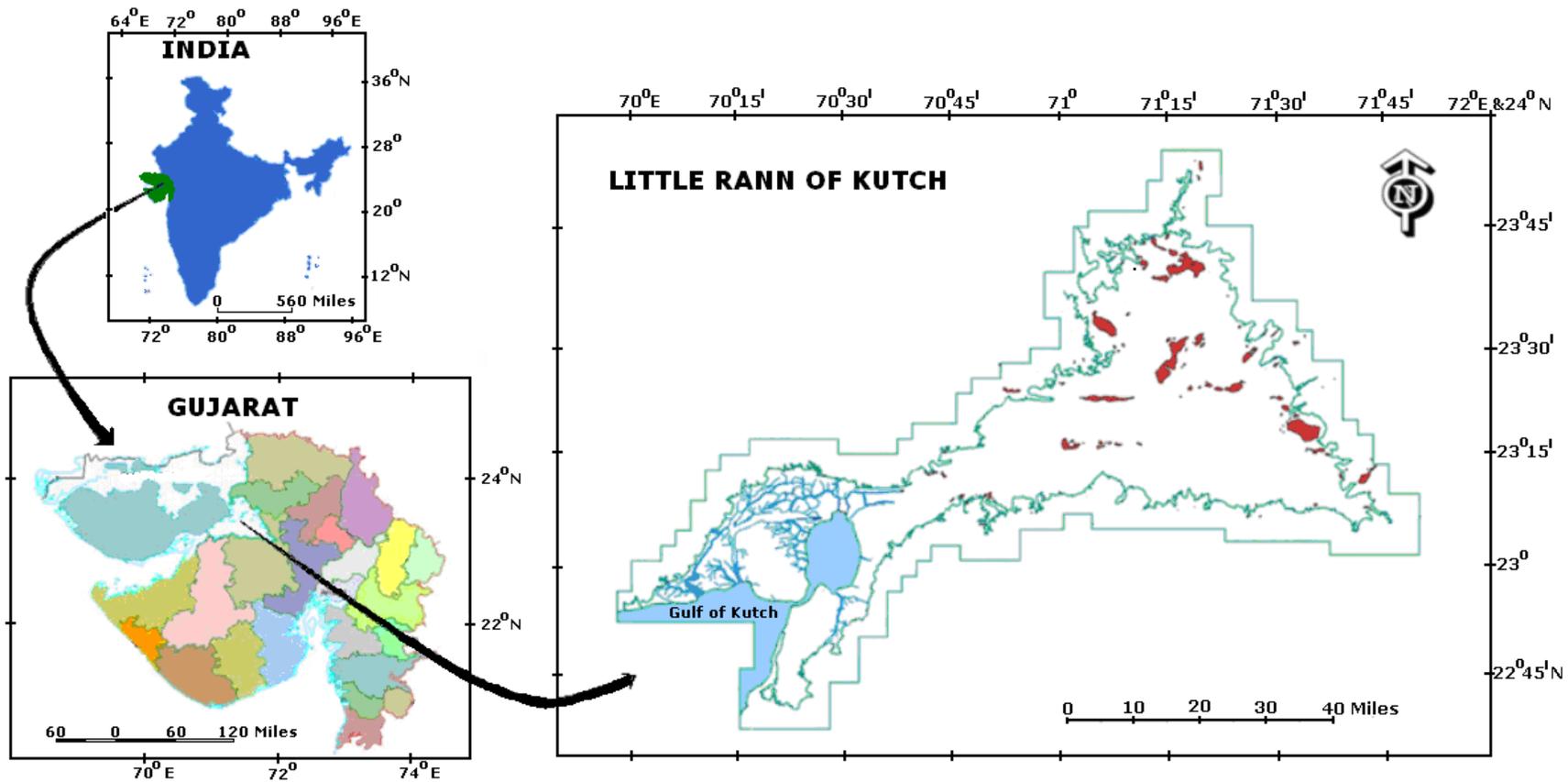
- (1) The two Ranns, (includes Great and Little Rann of Kutch).
- (2) The Banni Plain.
- (3) The Hilly Region.
- (4) The Coastal Plains.

The Two Ranns:

- (1) The two Ranns can be described as a unique salt encrusted monotonously flat waste land. Annual inundation of the area has translated the Rann as a piece of peculiar ground. Every year the Rann of Kutch gets flooded by water both fresh water from inland areas and saline water from the Gulf of Kutch. Ranns spreads over the north-western, north, north-eastern and eastern part of district with an area of 23100 sq. Km. The Great Rann covering an area of 18000 sq. Km., lies to the north of the rocky mainland beyond Pachham and Bela Island while Khadir Island lies in the midst of the Great Rann of Kutch. Further, south east of it lies the Little Rann of Kutch comprises with an area of 5100 sq. Km.

The Little Rann salt marsh & island (with an extension of 23° 7' to 23° 40' N Lat. ; 70°38' to 71° 44' E Long.) (Map- 2.1, 2.2 & 2.3), a sub division of Biotic province of Kutch Desert has been modified by the fluvial, aeolian and marine processes under two major wet & dry phases. The eastern most portion of the Little Rann area is free from sea water intrusion.

LOCATION MAP OF STUDY AREA



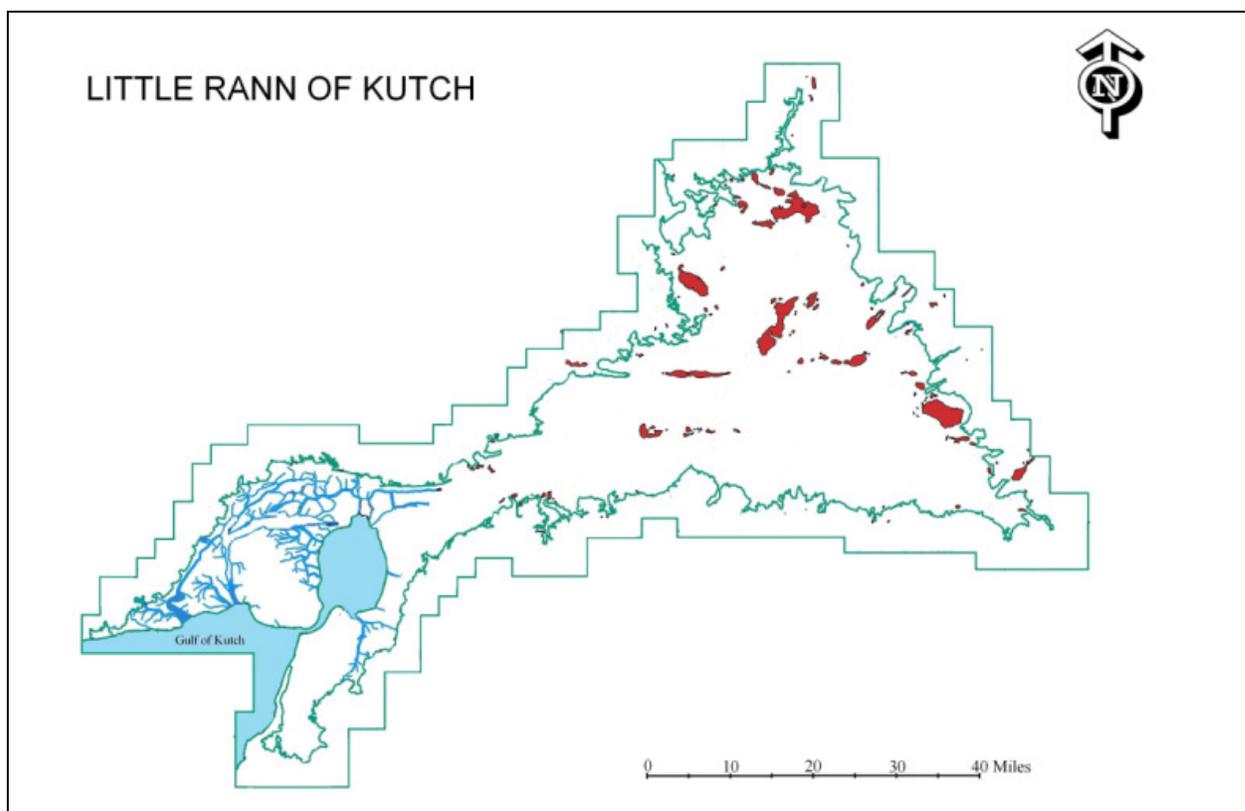
MAP - 2.1

MAP – 2.2 Topographical Sheet Index and Study Area

Topographical Sheet Index

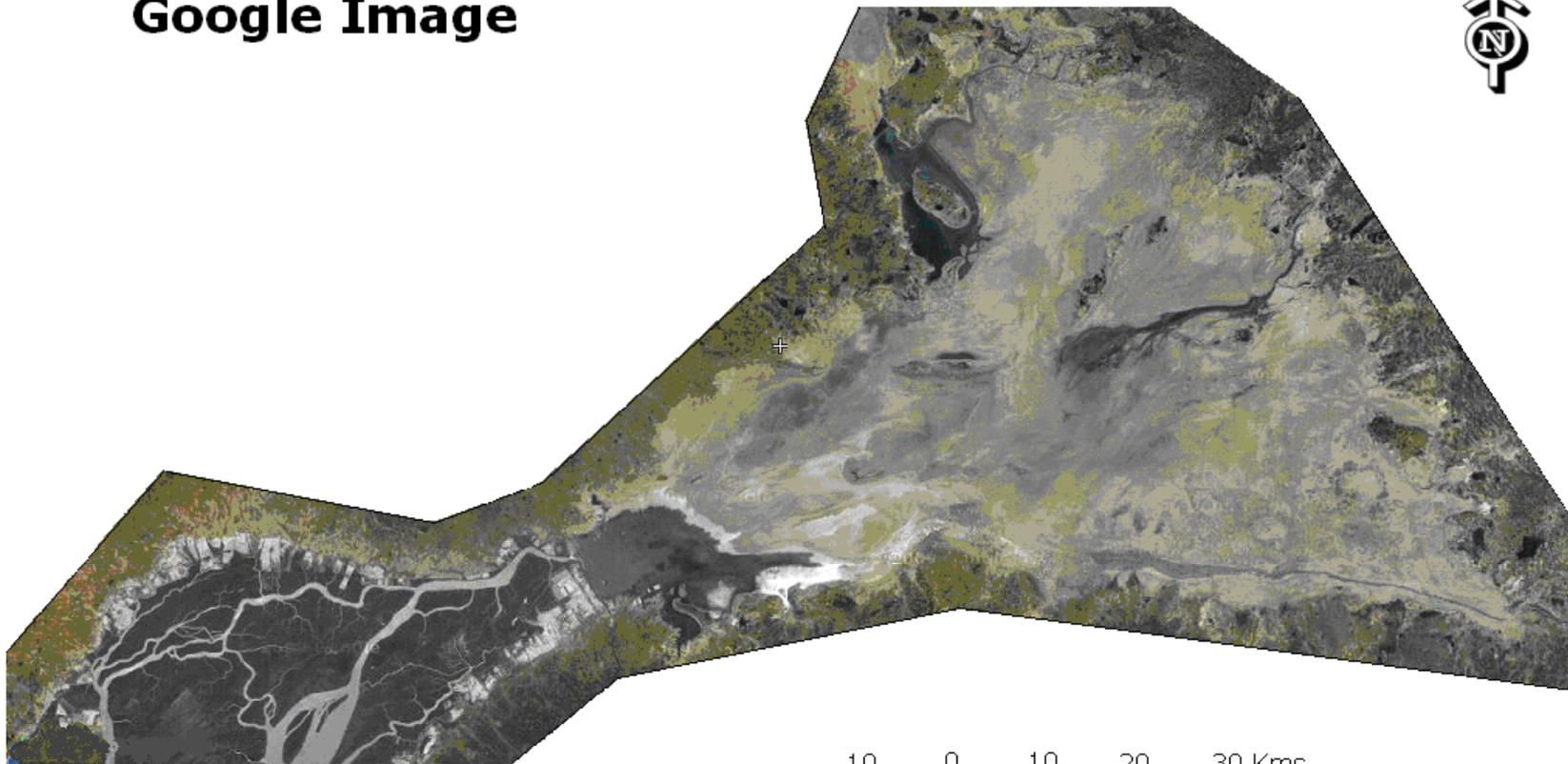
1	5	9	13	1	5	9	13
2	6	10	14	2	6	10	14
3	7	I	11	15	3	M	11
4	8	12	16	4	8	12	16
F/13	1	5	9	41	13		
	2	6	J	10	14		
	3	7	11	15			
	4	8	12	16			

Referred Sheets



LITTLE RANN OF KUTCH

Google Image



10 0 10 20 30 Kms.

MAP - 2.3

Except for the eastern part of the Little Rann of Kutch, the entire area is almost at par with the sea level. With the onset of rainy season, water starts stagnating on its surface. Several ephemeral rivers and local streams empty their water in the Rann area. At this point of time the south-west monsoon winds also drags water from the Gulf of Kutch and Arabian Sea area and contribute to the inundation of the Rann. During dry period, except for some permanent wet patches, the entire area is dried living behind salt encrusted land with varying degree. During the inundation period, several bets (island) can be seen rising above water. These highlands or bets are the only places in the midst of the Rann which supports some amount of plants while the saline waste land is completely devoid of vegetation. There is absence of any major river flowing into the Little Rann except for Banas, Saraswati and Rupen which enters from the north eastern part of the map. When the streams pour into the Rann they become broad pools of water occupying ill-defined channels. The lowlands occurring beyond the cliffs are due to the alternate depositional and upliftment processes. "The Rann of Kutch..... Becomes converted from a marine gulf to a..... Land which is flooded during the south-west monsoon and becomes a dry, barren, mudflat during the rest of the year; this is the result of silting up of the area aided by a slight elevation of the land"¹⁷.

The characteristic of fringe area lying along the margins of Little Rann of Kutch varies from one area to another, especially because of the amount of water available in the area. Of the three sides of the triangular Little Rann of Kutch, the eastern fringe enjoys a better ecological setup because of the presence of rivers. River Banas draining some part of eastern margin is an important river in the area, having two distributaries, bifurcating from the Adgam village. It forms a wide inland deltaic area camouflaging into the

¹⁷ Pascoe, E.H. (1964), "A Manual of Geology of India and Burma". Delhi, p.193.

Rann. The entire eastern referred area drained by river Banas has a height less than 20 meters, a 20 meters contour is passing east of Degam, a village, approximately 18 Km., lying north east of the mouth of river Banas. Wadesar town is located at the mouth of river Banas. Presence of relatively larger river in this climatically dry area has imparted it a very fertile soil and the area is rich in agricultural terms.

South of River Banas, lies River Saraswati, having a well defined extensive wide mouth opening into the Little Rann of Kutch. It does not have any prominent distributaries.

Further south, the area is drained by river Rupen. Rupen in its final course runs roughly straight east to west for 30 Km. before draining into the Little Rann of Kutch. Numerous small reservoirs have been made along the distributaries of Rupen. The catchment between River Saraswati and Rupen is divided by scattered low uplands rising upto a contour of merely 20 meters. The case is similar to the southern water divide lying along the left bank of river Rupen.

Minor streams like Kharwa Ka Nala and many other unnamed small streams, even less than 2 Km. in length drains the surrounding rain water in the Rann. The plain topographical characteristics have a great role in the development of such numerous parallel independent streams.

The presence of three major streams that is Banas, Saraswati and Rupen has made this area fertile through annual flooding. Spasmodic floods are common phenomena in the area. Apart from the rivers, presence of Talav and Sarovar helps to meet the year around demand of water. Jhinjuvada village have clusters of Sarovar such as Jera Sar, Vihari ka Talav

(plate No. 15). These water bodies also attract hosts of migratory birds. Jhinjuvada is an exception in terms of its height, it attains a height of 20 meters, in spite of being merely 2 Km. away from the Little Rann of Kutch boundary. The Further south-east of Jhinjuvada lies the Vila Sar and Navu Talav are largest in this zone. Other water bodies are in Mithaghoda and Chikasar. There is fairly dense scrub all along the streams forming a buffer zone along both banks of the streams. Also, in between the areas of Little Rann of Kutch and the surrounding lies a zone of intermixing where both loses its characteristics. This zone of intermixing is characterized by the availability of clumps of grasses and open scrub of Juliflora in the salt waste.

The major rivers joining the southern margin of Little Rann of Kutch are Godra, Kankavati, Bambhan and Machchhu from east to west. These main rivers originate from the Saurashtra peninsula and flows northward to find themselves in the Rann. There are other small streams which together makes a parallel orientation towards Little Rann of Kutch. The presence of salt waste land with grasses along the southern margin of Little Rann of Kutch is discrete in nature. However, the extent of vegetal cover increases along the mouth of rivers. River Bambhan being the largest in the region has created extensive salt waste grassland just at its mouth in a triangular shape.

Though the salt is being extracted from numerous sites, Kharaghoda and Kuda are the important salt processing centers. Along the south-west margin lies Karadiya, Venasar and Ghantila protected forest area mainly covered with scrubs and isolated trees. Except for some isolated hillocks, the general relief of the eastern and southern fringe area is as low as less than 20 meters of contour, which passes 10 Km. east and south of referred fringe area.

The similar physiographic characteristic as that of Little Rann of Kutch also continues along the southern margin of the Gulf of Kutch. Here the dry salt Rann is separated from the gulf through a narrow margin of mud flats. The network of creeks becomes very prominent in the entire south west part of area. These creeks support an extensive mangrove forested area. Mangroves in this area are of drowned valley type. The Hansthal creek connects the Gulf of Kutch to the Little Gulf of Kutch, which drains the study area. The important creeks are Sui, Guduba, Varasamadi, Wanki, Lara, Patar, Phuljara, Hadkiya, Chach, Morwali, Dantewali, Bhojawali, Lakada etc. Navlakhi port is located along the left bank of Sui creek. Other important creeks to the west are Kandla, Khori and Nakti creek. The entire area is similar to that of the western most part of Little Rann of Kutch, with a very high density of creeks, mangrove swamps, mud, patches of dry salt waste Rann and the salt pans. Further outward, landcover transforms to the grasslands and then barren.

The mangroves have made a buffer zone along the both bank of creeks. It is because of these patches of mangrove that proportion of mangrove forest of Gujarat is higher than the rest of the country's coastal area.

There is Mamlia group of island lying in the midst of the Little Gulf of Kutch. The present orientation of the gulf shows the westward movement of creeks, resulting into the formation of creek islands.

Along the western margin of Little Rann of Kutch, the contours as high as 20 meters start appearing just 2-3 Km. These contours also acts as water divide for many small streamlets and therefore, the streams joining the Little

Rann of Kutch from north are of short length with smaller catchment area. The presence of Goa Dungar and Gul Dungar with a height of 92.6 meters and 46 meters respectively also acts as a water divide in the north. Ranotar Nadi is the only important stream of the western fringe draining into the Little Rann of Kutch. The characteristics of climate and vegetation in the area have made it ravines of lower order. Stony and gravel wastes are also a common features close to Vejapur and Sukhpur.

Pung bet is an elongated bet lying parallel but at a distant proximity to the western margin of Little Rann of Kutch. This bet is covered by fairly dense scrubs, making homes for various wild lives. Headward erosion on the bet is very prominent, and has resulted into the division of the Pung bet into numerous smaller bet such as Dhutari Mata bet, Dhana Bir and many other still smaller bets. Even the Pung bet (main) is also very narrow at some places. This bet appears as a ridge rising low from the ground upto a height of 10-13 meters.

Another group of bet is Wasra Solanki bet and its companion bets lying on the same plane (latitude) are Maharajawali, Miyan, Khijadiya, Andheri Wen and few very small bets. Wasra Solanki bet have a dense cover of scrubs while on other it is very sparse. Grasses and low xerophytes are prominent on the bet owing to the low availability of soil moisture.

Another major island/ bet are Jhilandhan bet. The relief of this island seems to be at par with the nearest surrounding fringe area, Jhinjhuvada, having the contour of 20 meters passing close to it. There are several other islands lying north and south of it in the same orientation. Jhilandhan appears to be a newly formed bet, separated from the main land by a narrow strip of dry salt waste. This bet is roughly in rectangular shape with

an area of more than 25 sq. Km. There are numerous jhils on the bet as for example Jhilleshwar Kund, Nawa Talav, Londe Sar etc., and that is why this bet is known as Jhilandhan bet. The seasonal streams flowing north and south from the central upland (running west-east) has resulted into the development of badlands of lower order. Grasses, mixed jungles and open scrubs are the general land-cover of this bet. There are numerous temples and permanent dwelling places on the bet, owing to the availability of water. The highest point with a height of 27 meters is reached east of Naleshwar temple.

Mardakh Bet lying in the midst of the Little Rann of Kutch is usually a gravelly stony waste, running west to east in two pieces, divided by a narrow strip of dry salt waste. This bet has coverage of very scanty vegetation. Maximum height of this bet is reached at the eastern half of this bet, rising upto 55 meters.

Nanda bet and Shedwa bet lying at a close proximity to the western margin is relatively greener patch than that of other lying in the midst of the Little Rann of Kutch. There are good number of settlements and patches of cultivated area as well. The lengths of the streams draining towards south are lengthier than their northern counterparts because of the local slope elements of the bet. Both these bet have fairly dense scrub.

Ganesari and Keshmara are the other two groups of bet lying to the north and south of the Little Rann respectively. Both orient itself in the direction east-west, with marginal growth of scrubs.

The Banni Plain:

It lies in between the Great Rann and the more stable rocky landmass i.e., mainland of Kutch. It is covered with grass and other shrubs. This plain is drained by ephemeral rivers originating from the northern slope of Kutch

mainland and the southern slope of Pachham hills. The plain remains as a lake of intermediate salinity for few months after the monsoon, the duration largely depends upon the amount of rainfall it receives. During post monsoon season this plain (lake) becomes breeding ground for several migratory birds.

The Banni plain is the recent uplift and symbolizes the following edge of Allah Bund fault, which is shifting from south-west to north-east towards Asian plate. The leading edge of this fault is characterized by scattered & disintegrated uplifted range (comprises of Pachham, Khadir, Bela and Chorar uplift) in the sequence of three uplifts as witnessed by the region. At micro level grassland of similar morphological characteristics can be seen in the fringe area of the Little Rann of Kutch, where the fresh and saline water gets enclosed within the relatively shallow areas.

The Hilly Region:

The hilly regions can be divided into three divisions;

- (1) Island Belt ,
- (2) Kutch mainland and
- (3) Katrol hill

The island comprises of discontinuous hills and forms four islands viz; Pachham, Khadir, Bela & Chorar which runs west to east. Kala Dungar with a height of 465 meter in the Khavada hill (Pachham Island) is the highest point in Kutch. "There is marked and bold line of cliff for some 25 Km. lengths on the northern end of Khadir Island, the cliff being about 80 -160 meters high within a width of some 200-400 meters from the shore, such dead cliffs also occur round other islands, example- Kakinada Bet, Bhanjada Bet and Jalandar Island lying in the Little Rann of Kutch"¹⁸. Such dead cliffs

¹⁸ Ahmad, E. (1972), "Coastal Geomorphology of India". Orient Longman Limited, Asaf Ali Road, New Delhi, p-121.

and ill-defined streams away from the coast suggest Transgression of sea or submergence in the recent geological era.

The Kutch Mainland is by far the most extensive, continuous, broad as compared to the other two hills and runs from Kori creek in the west and merges to the Little Rann of Kutch in the East. This range exhibits hogback appearance with a relatively steep northern slope where as southern slope is relatively gentle. Dinodhar, with a height of 388 meter is the highest peak of the Kutch Mainland. The Wagad highland lying in the north west of Little Rann of Kutch guides the orientation of small streamlets flowing towards the Little Rann in almost perpendicular direction.

The Coastal Plains:

The coastal plain is bordered by Katrol hill in the north and Arabian Sea from south and west. The coastal plain is of various characteristics. It is sandy at some places and at some place it is muddy and possesses a character of marshy area. The southern shore of Gulf of Kutch is indented in spite of the low level coastal plain surface to its north. The shore line exhibits submergent characteristics through its marked indentations, number of offshore island, several estuarine river mouth and number of deep inlets, and thus, having multiple characters in terms of its coastal outline. The indentation in the coastline has facilitated a lot in the development of various port and jetties such as Kandla, Mundra, Jakhayu etc. the coastal region of Kutch is formed by a belt of alluvium. It consists of wind blown loam and sand underlain by clay 5-16 Km. wide. Solid rocks also appear at several points on the shoreline. "Between the alluvial belt and the trap there are two belts of Tertiaries roughly parallel to the shore. The older band consists of clays and limestones and is exposed between Jakhayu and Koteshwar in the Khari river section and is of Eocene age. The younger beds

are sandstone and clays ranging in age from lower Miocene to Pliocene (exposed in the Dhrangdhara)¹⁹.

The Gulf of Kutch:

Gulf of Kutch is an inlet of the Arabian Sea in the western India. It is about 50 Km. (30 miles) wide and extends for about 160 Km. (100 miles) between the Kutch and Kathiawar Peninsula. The head of the gulf of the north adjoins the vast salt marsh known as Little Rann of Kutch and regularly inundates the Little Rann with the saline water during tides or through the water drifted by the south-west winds.

¹⁹ Ibid.

2.3 ECO-CLIMATIC SETTING OF THE LITTLE RANN OF KUTCH

CLIMATE

Temperature and Rainfall:

The region is characterized by a high aridity index of over 40 percent, which indicates a very high deficiency of soil moisture. The Kutch district falls under the semi-arid type of climatic conditions, which belongs to the "Steppe-Bush type" as per the Koppen's classification. The climatic characteristics of area shows transitory phase between the arid and semi humid type in the west and east respectively. The intensity of heat goes on increasing from east to west in the Little Rann except in the coastal zones. The area experiences a typical arid climate may be because the tropic of cancer passes through the Kutch. The mean annual temperature is 26° C with mean maximum and minimum of 30° C and 10° C respectively. The maximum temperature in May is about 40° C but some time it records a very ambient temperature of 48° C, leading to the development of very low pressure cells. During this period violent storms are very common. These violent storms or winds are of less duration and occurs in the afternoon regularly because by that time the low pressure develops to its fullest. A very harsh northerly and easterly wind prevails in winter season, followed by strong South-Western steady winds. The moving air masses remains always loaded with dust and salt and are carried to more inland part of the India and Pakistan. Holland (1912)²⁰ in his research paper stated that some 130000 tons of salts are annually carried by the wind into Rajasthan only. January is the coldest month, in which mercury drops upto 9° C. The area receives rainfall from June last to August, followed by the setting up of

²⁰ Holland, T.H. (1912) "The origin of desert salt deposits". Proceeding of Liverpool Geological Society, vol. 11, Pp.(227-250).

winter from the middle of the November to the end of February. The area do not experiences a very cold climate but is associated with occasional cold waves. Further winter is followed by the summer from the March to July end. The period in between middle of May to the end of August is the monsoon period, of which July is the wettest month. Here the unavailability of obstruction of required height reduces the amount of rainfall received in the area. The average annual rainfall is even less than 25 mm. in some area where as annual rainfall for the Kutch district is 320 mm. with dependability of less than 40 percent; total rainy days are less than 15.

Humidity:

On an average the humidity of the area is less than 25 percent during most part of the year. However, humidity varies locally i.e., it is as much high as along the coastal area and it even increases to more than 85 percent during the monsoon season.

Soil:

The surface of Little Rann of Kutch exhibits itself in terms of dark brown surface configuration with wide and deep cracks with veneer of salt. Generally in the semi arid regions of the tropics and sub tropics, there is pre dominance of deep dark colored clay soil, particularly in the flat topographical areas. Such deep and dark colored clay are called Vertisols. Dark color of soil is related to either parent material or presence of manganese oxides. The dark brown-black color of the Rann sediment is attributed to the parent material lying in its catchment area of basaltic geological structure.

Overall, Aridisol and Entisol orders dominate soil of the Kutch peninsula. The soil of the mainland areas is characterized by varying depth

and textures. The soil of this region is moderately calcareous and alkaline. The area exhibits the eroded face with a thin layer of soil at some places while at some the rocks are exposed on the surface. The soils occurring on undulating pediment surface are dominantly very shallow to shallow (10-15 cm.). The soils in this area are loamy in texture and are excessively drained. The gentle sloppy pediment surface are skirted by moderately shallow to moderately deep (50-100 cm) of well drained and fine loamy textured soil and are slight to moderate alkaline and calcareous in nature. Broadly, the soil of this region is divided into four types: Alluvial, Sandy, Swampy and Black clay or Loamy.

Flora and fauna:

Biogeographically, Kutch is classified as desert as per the classification (WII, Dehradun, 1988)

Biogeographic zone	3	The Indian Desert
Biotic province	3A	Kutch desert
Sub divisions	<u>3A (I)</u>	<u>Little Rann salt marsh & islands</u>
	3A(II)	Great Rann salt marsh & islands
	3A(III)	Southern hills

Little Rann of Kutch with 23 islands encompassing 5180 sq.Km. area, is the southward extension of the Great Rann & is similar in Physiography, edaphic conditions, ecoclimatic & vegetation but differs in inundation regime.

Greater part of the Kutch except inter mediate zone in between the hills possesses desolate landscape with very scanty vegetation. In the Rann

the vegetation is confined only to the island bets which have a thin layer of soil where as the Rann terrain is encrusted by evaporated salt and hence there is no vegetation.

The natural vegetation of the Kutch area could be classified into two major types.

- (1) Halophytic vegetation near sea and
- (2) Typical low thorny shrubs i.e, "Xerophytes" in the fringe.

Major types of halophytic plants present in this area are *Cress Cretica*, *Abeurapa Sp.*, and *Chenopodium Sande*. The xerophytes include low and stunted trees of *Acacia Arabica* (Babul), *Prosopis Spicigera*, *Prosopis Julifera*, *salvadora Persica* (piludi), *Catotropic Gigantis* (Akoda), *Capparis Aphylla* (Kerdo), etc. The islands (bets) are sparsely covered by *Prosopis Julifora* (Gando Bawal), *Accacia Nilotica* (Desi Bawal), *Prosopis Cineraria* (Khijdo/Kando), *Buteq Frondosa* (Khakhro).

Kutch in general, with arid land, vast saline desert, a huge coastline with several indentations in the form of estuary provides a wide variety of wildlife of its own kind.

Government of Gujarat has notified two important wildlife sanctuaries in Kutch viz; the Kutch desert wildlife sanctuary in 1986 which spreads over an area of 750622 hectares of land shared by Anjar, Bhachau, Bhuj and Rapar Taluka. This sanctuary is also spreaded in the Great Rann and Little Rann of Kutch (Wild Ass Sanctuary of Dharghandhra). The other notified sanctuary is the Narayan Sarovar sanctuary in Lakhpat Taluka.

The marshes of Kutch are the only breeding ground for Flamingoes in India. In a cycle of once in a decade, when conditions are favourable, Flamingoes descend in thousands to breed on islands in the Rann. This area is known as *bird watcher's paradise*. Many migratory birds like the sea gulls and white storks visit Kutch, the ducks come from Siberia. The wetlands around the Rann provide a congenial habitat for the avi-fauna and spoonbills. The greater and smaller flamingoes are the famous birds which are seen through out the year. The waterfowls are seen in plenty mainly the ducks, goose etc. the great Indian Bustard is one of the rarest birds in India and is known locally as tiller. Several species of reptiles including crocodile, snakes and amphibians are found in the study area. Some of these are very common such as spiny tailed lizard or sanda, matt-tailed lizard known as khann, fresh water turtle, tortoise, monitor lizard, crocodile and poisonous and non-poisonous snakes.

Therefore, it is apparent from the above discussion that the area in spite of having harsh and tough ecological setup particularly in terms of climatic condition, hosts variety of flora and fauna.