

## Natural and Human Dimensions of Semiarid Ecology; A Case of Little Rann of Kutch

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### Abstract

The intermittent drought and flood, crafts the ecosystem of the semi-arid area and make it more fragile. The Little Rann of Kutch (LRK) falls under the zone of northern semiarid climate. The LRK is located at the junction of phytogeographic provinces and is composed of diverse floristic elements. The area experiences extreme climatic conditions- get flooded by both the tidal water ingression and fresh water poured by the seasonal rivers during the monsoon season, whereas during summer season the water recedes and evaporates, leaving behind a crust of halite and gypsum crystals which grow in clay and sand. The distribution patterns of biotic elements & human ecology are at large explained on the basis of bioclimatic conditions prevailing in the area. Anthropogenic activities such as pastoral, salt mining & dry farming not only advocates climatic characteristics of the region but also reduces vegetal cover, subsequently, the soil is lost through erosion and thus the environmental degradation results. A systematic account of the ecological resource has been carried on a regional framework, in order to propose, a case sensitive strategies for protecting biodiversity, resource management and to improve quality of life in semiarid lands.

**Keywords:** Desertification; Ecology; Exploitation; Restoration; Semiarid region

### Introduction

“The situation (Desertification) has been likened to a skin disease in which existing eruptions worsen and coalesce with new outbreaks of the disease. And, as with any disease, treating the symptoms is secondary to tackling the causes Tolba [1]”. Socio-ecological systems of the semi-arid regions of the world are threatened, for approximately 30% of the population depends on interactions with dry land systems for their continued survival. With decreasing availability of surface & sub-surface water, reference to increase in population, semiarid regions are expanding. Dregne [2] states; (semi-)arid represent 30% of global terrestrial surface area. The said condition is reached either through low recharge rates or through excessive rate of Evapo-transpiration. Arid and semi-arid or sub-humid zones are characterized by low erratic rainfall of less than 70 cm per annum, periodic droughts and different associations of vegetative cover and soils. Variability of rainfall varies from 50-100% in the arid zones of the world with averages of up to 35 cm. In the semi-arid zones, variability of rainfall varies from 20-50% with averages of up to 70 cm. Regarding livelihoods systems, in general, light pastoral use is possible in arid areas and rain fed agriculture is usually not possible. In the semi-arid areas agricultural harvests are likely to be irregular, although grazing is satisfactory [3]. UNEP's Desertification Control/Programme Activity Centre defined desertification as "land degradation in arid, semi-arid and dry sub-humid areas resulting mainly from adverse human impact", aggravated by the characteristics of dryland climates. Desertification has also been defined as "land degradation in arid, semi-arid and dry sub-humid areas resulting from climatic variations and human activities". In the former, human intervention is viewed as the central driving force in desertification; while the latter clearly identifies both human and climatic influences [4]. Catastrophe Basic problem of such area is over dependence of population over primary activities. The majority of the population of arid and semi-arid lands depend on agriculture and pastoralism for subsistence. These zones exhibit ecological constraints which set limits to nomadic pastoralism and settled agriculture [5]. Environmental degradation in the form of soil erosion results in the area because of anthropogenic activity such as reduction of vegetal cover against marginal cropping, over- grazing, mining etc. The

programme for ecological management must be based on the survey of historical land use pattern and potential productivity of the region. This research work is yet another attempt to look upon the critically important challenges of semiarid restoration, through systematic account of the ecological resource on a regional framework as devised by Gupta [6], in order to understand the causal chain of actions that leads to desertification considering the environmental impacts of past actions and thereafter, and to propose valid strategies & methods of restoration through case sensitive strategies for protecting biodiversity, resource management and to improve quality of life in semiarid lands, on the basis of petrography analysis.

### Material and Methods

The study focuses on the ecological management of the semiarid area through the better understanding of ecological parameter. The field study being the very foundation of this work was carried out in order to understand the ecological characteristics of the area. Petrographic analysis has been carried out to build the relationship between the soil-type its geomorphic characteristics & the floral and faunal cover. The data base on climatic parameters was collected from various secondary sources. Basic information on the study area has been collected from published and unpublished reports, journals, books etc. In addition to it, uncounted interviews with various experts, officers and workers of salt industries and villagers were also carried out. Offices such as Gujarat Institute of Desert Ecology, Gujarat Ecology Commission, Gujarat Institute of Desert Ecology in Vadodara, Department of Forest in Vadodara etc. were visited during the initial stage of the study. Base

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map for the mapping has been generated through the digitization of topographical sheets of quarter inch to miles. The representation of various phenomena has been done through Arc GIS tool. The available maps from secondary sources were geo-referenced with the base map in order to show attributes on a self-generated map.

## Study area

The Little Rann salt marsh & island, with an extension of 23° 7' to 23° 40' N Lat.; 70° 38' to 71° 44' E Long. and 23 islands encompassing 5180 sq. Km. area (Figure 1) is the southward extension of the Great Rann & is similar in Physiography, edaphic conditions, ecoclimatic & vegetation but differs in inundation regime & geomorphological setup (Figure 2). Biogeographically, Kutch is classified as desert as per the classification. Little Rann of Kutch, 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 seawater intrusion. Geologically, this area was a part of oceanic floor and has immersed in the recent past. Geomorphology of the area plays a dominant role in the pattern and cause of saline water intrusion. The surface of Rann is at or slightly above sea level and possesses a monotonously plain character with some outcrop in the form of sandstone capped by basalts, resembling to island in the mid of the Rann. An important feature of the study area is the higher proportion of incoming water that is returned to the atmosphere through evaporation, mainly from the soil surface. Therefore evaporation is a major Factor in reducing water storage in the study areas. The recurrent drought and flood make the ecosystem of the area more fragile. Spasmodic storm water drainage, its regulation and water resource management is an important phenomenon to deal with in the semi-arid regions.

## Ecology of Little Rann of Kutch

The Kutch district falls under the semi-arid 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 district except in the coastal zones. The region experiences four main seasons namely winter, summer, South-west monsoon and post monsoon seasons. During winter season (December to February) winds are N-NE and rough sea conditions may prevail because of western disturbances characterized by chilly winds from the N-NE due to high pressure zone in the north of Himalayan ranges. Summer season (March to mid-June) is characterized by high temperature and high humidity with the maximum air temperatures often reaching 40-45°C. Southwest monsoon (mid-June to mid- September) has weak monsoon mainly due to monsoon low centered around more inland part making it a low rainfall area with strong winds with S -SW directions. Post monsoon season (mid-September to November) is a transition period between monsoon and winter when the climate is pleasant with relatively calm periods.

Following are the climatic characteristics of the study area:

1. The region is characterized by a high aridity index of over 40 percent.
2. The mean annual temperature is 26°C.
3. Average temperature of the coolest month (January) is 10°C.
4. The mean maximum and minimum temperature is 30°C and 10°C respectively.
5. Maximum temperature during summer month sometimes reaches upto 48°C.
6. There are three rainy months i.e., June to August of which July is the wettest month, receives almost 80 percent of the total rainfall received in the area.

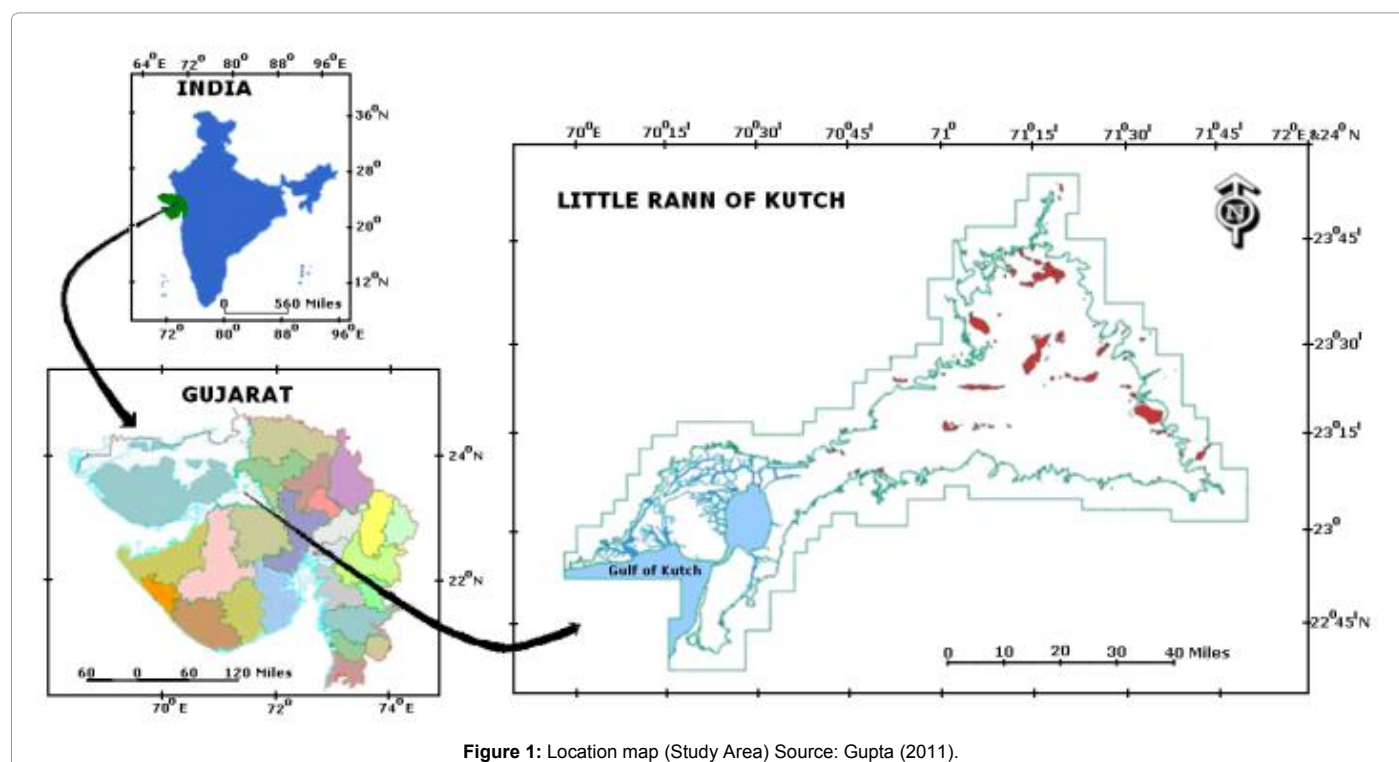
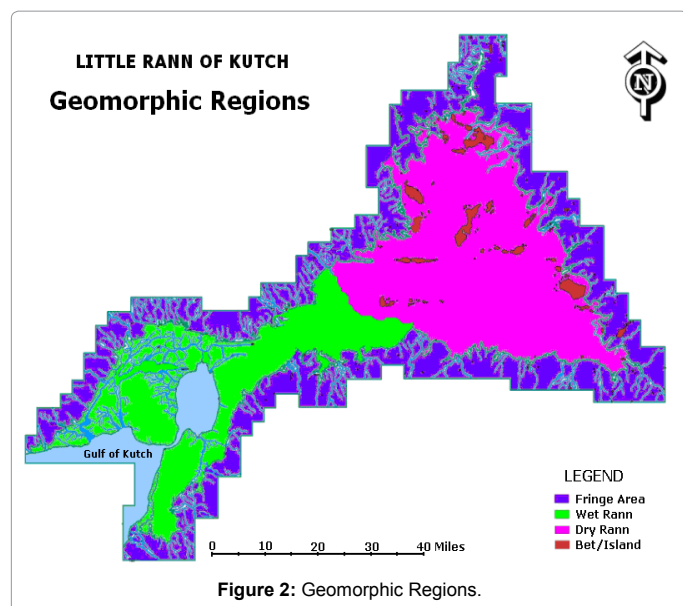


Figure 1: Location map (Study Area) Source: Gupta (2011).



- There is definite dry period starting from October to May within which there is insignificant amount of rainfall.
- Average annual rainfall for the area is 320 mm with dependability less than 40 percent.
- Total rainy days are less than 15.
- Annual rainfall is variable, the coefficient of variability being 14.01 percent in
- Kutch, 9.46 percent in Surendranagar and 7.841 Percent in Rajkot.
- The average humidity of the year is less than 25 percent.
- Humidity during rainy and post rainy season that is from June to October even goes upto 80 percent.
- Strong summer winds, which blow from SW and W and often carry salts from dried salt encrustation of the Ranns towards the land, is also one of the factors contributing salinity to the area.
- The Little Rann of Kutch experiences maximum Evapo-transpiration rate owing to the low mean annual precipitation and a moderate mean annual temperature. May month remains volatile because of violent storms and winds, generally of short duration, more particularly in the afternoon. Winters are associated with harsh northerly and easterly wind and are occasionally associated with cold waves. The area do not receives good amount of rainfall because of unavailability of orographic elements. The above reality, principally confirms the criteria of alternating wet and extreme dry season, which is also manifested through vegetation and soil type.

The socio-cultural practices, such as pastoral, lumbering (of mangroves) and salt mining in the area reflects to the dry (steppe-Bush) type of environment. The seasonal pastoral migration of the people associated with absence of agriculture and seasonal salt mining, all indicates the climatic condition, soil type & condition available for vegetative growth. Looking to the condition of the vegetal cover in the Rann, Champion and Seth [7] the vegetation of Little Rann of Kutch as Rann saline thorn Scrub and Tropical Euphorbia scrub at its

degradation stage. Gupta and Saxena [8] categorized this vegetation as Halophytic scrubland. The vegetation types present in semi-arid zone of India are characterized according to their degree of aridity as envisaged by Meher-Homji [9]. Joshi [10] points out the earlier records of mesquite GandoBawal (*ProsopisJuliflora*) cultivation in Indian subcontinent back to 1877. In area adjacent to the Little Rann of Kutch, mesquite was introduced by the then ruler of Radhnapur during 1899-1900. These tree act as a home for the bees and the area is known for honey production. However, the plantation of *P. Juliflora* in the fringe grassland has displaced the natural shrub species. In 1954 the plantation of mesquite was taken up by the Department of Forest under the programme, "Immobilization of Kutch Desert" in the waste lands around the Little Rann. Work of Shah [11] reveals that shrubs has not only secured a foothold but is rapidly spreading and is now by far the most economic species of the region, and is being increased through afforestation. The Little Rann of Kutch has diversity of vegetation types and all representing extremities of climatic conditions. The Little Rann (main) is a saline mud flat with absolutely no vegetation. The islands (bets) in the Rann are the only vegetated island in the midst of the dry and barren Rann, having shrub and grass cover. Around the barren Rann is a vegetation belt mainly prosopis shrubs and grasses. Vegetation is more conspicuous in the eastern and southern fringe, whereas in the western fringe the vegetation is very sparse. Vegetation was only observed in the fringe and the bet area. Mangroves were seen along the coast on the south west boundary of Little Rann of Kutch. The natural vegetation in the area is variable owing to the variation in the other morpho- ecological parameters. The natural vegetation types, upto a great extent is limited by the soil properties such as the high clay content in the study area. The role of climate is equally important in determining the vegetation types to grasses and the pace of growth, extent of root penetration, their morphology etc. Even the trees of same species show differential growth pattern in different micro-climatic zones as for example *Acacia* are found in varied climatic zones with different morphological characteristics. The main feature of the natural vegetations in the study area is its tolerance to drought, as well as development of deep roots to overcome root damage as a result of the annual cracking. In general vertisols have grassland or Savanna vegetation as the native vegetation, and is true with the study area in correspondence with the moisture regime of the Little Rann of Kutch and its fringe zone. 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), *ProsopisSpicigera*, *Prosopis Julifera*, *salvadora Persica* (piludi), *Catotropic Gigantis* (Akoda), *Capparis Aphylla* (Kerdo), etc. The islands (bets) are sparsely covered by *ProsopisJuliflora* (GandoBawal), *Accacia Nilotica* (DesiBawal), *Prosopis Cineraria* (Khijdo/Kando), *Buteq Frondosa* (Khakhro). With an understanding of soil's physical properties and its relation to soil moisture, one can take a better ecological management decision. Soil texture and structure influence permeability, infiltration and water holding capacity. Both soil texture and soil structure determine pore space for air and water circulation, erosion resistance, looseness, ease of tillage, and root penetration. While texture is related to the minerals in the soil and does not change with agricultural activities, structure can be improved or destroyed readily by choice and timing of farm practices. The soil in the study area is in the state of deterioration because of compaction. The biological scope of soil is much less because of its dense nature and low porosity and permeability which accelerates the run-off rate and thereby erosion, more particularly in eastern fringe zone. Although the water holding capacity of the Rann sediment is very high, the hydrological conditions restricts Rann to support the vegetation. The study area had

some distinct variation in terms of its geomorphic characteristics and the land-cover at micro-level. And, on the basis of those variant the study area has been divided into various regions viz; “1) Fringe Area, two miles of frontier around the study area 2) Dry Rann, Eastern and Central part, 3) Wet Rann with numerous creeks, western part & 4) Islands” [6]. After a thorough analysis of these identified units, its relief, superficial expression, technically feasible and economically viable landscape management has been thought of to restore the fragile geo-ecological balance of the area (Table 1). The study area in question has also been classified on the pretext of Geo-environmental region (Figure 3) The detail study of the area unveils the challenges associated with it and also reveals its physical and ecological capabilities for restoration and landscape management.

### Fringe area

This unit, on ecological perspective is not as extreme as that of the main Little Rann of Kutch in terms of climatic condition. There is variation in terms of soil type and therefore on the land cover of the area. The height of entire fringe area is more than 10 feet. The depth of standing water at some places goes upto 3 feet during monsoon season. In terms of its superficial expression, it is gently sloping plain frontier joining the Little Rann of Kutch. This zone is rilled & gullied by local small streams (Figure 4). Relatively less compaction of soil in the fringe area offers better permeability capacity and therefore better vegetation. The petrographic analysis reveals the dominance of sand in the soil in the northern, north-western and along the bank of river Banas and Rupen. These soils get washed away with plant nutrients and therefore are less fertile & productive. These soils are veiled by a thin layer of fine clay when flooded and gets parched to flakes during dry season. The marginal area being comparatively elevated to that of Rann did not get inundated and is evenly dotted with Prosopis scrubs. The intermittently dropping stream deposits pebbles, cobbles, sands, silt and clay in this area. Comparatively, soils of this area are sandier than any other areas of study. Bawar, Bordi, Aawad, Pilu, Sankhpushpi,

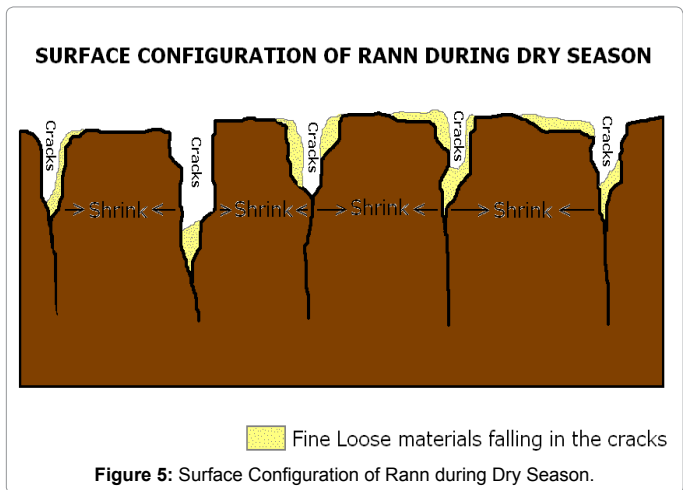
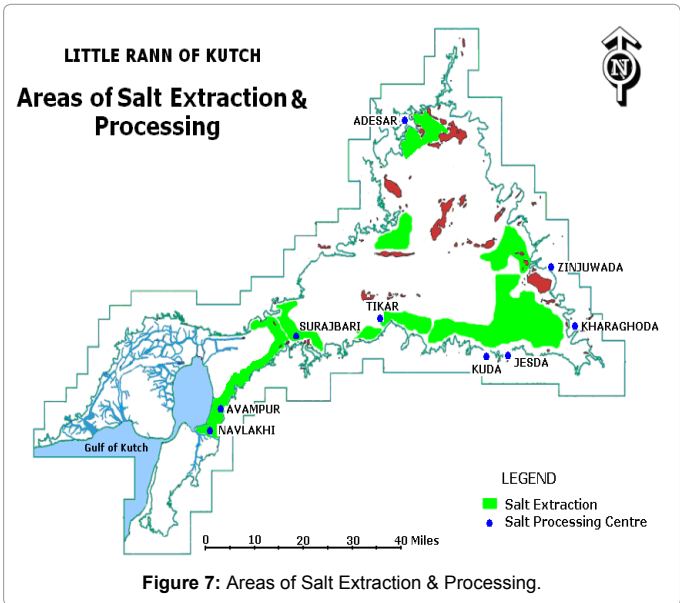
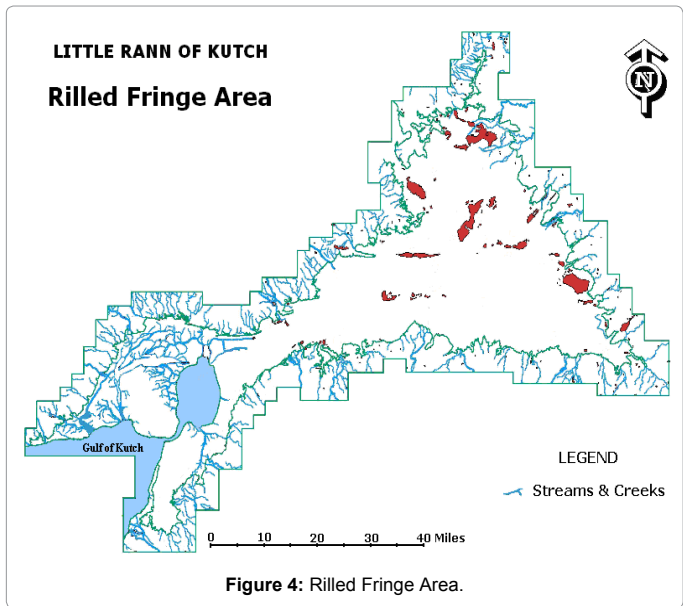
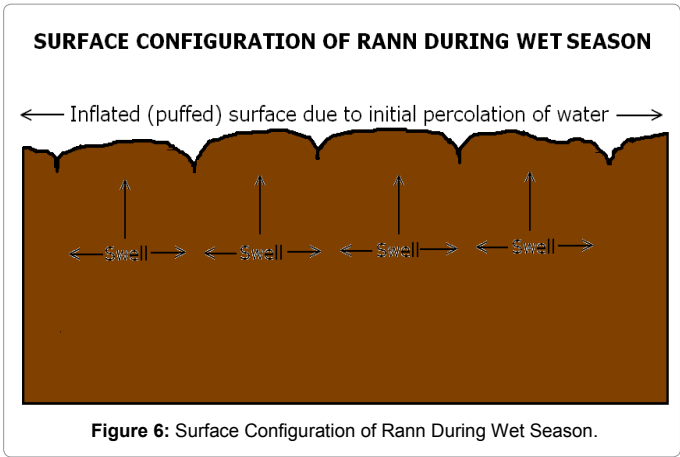
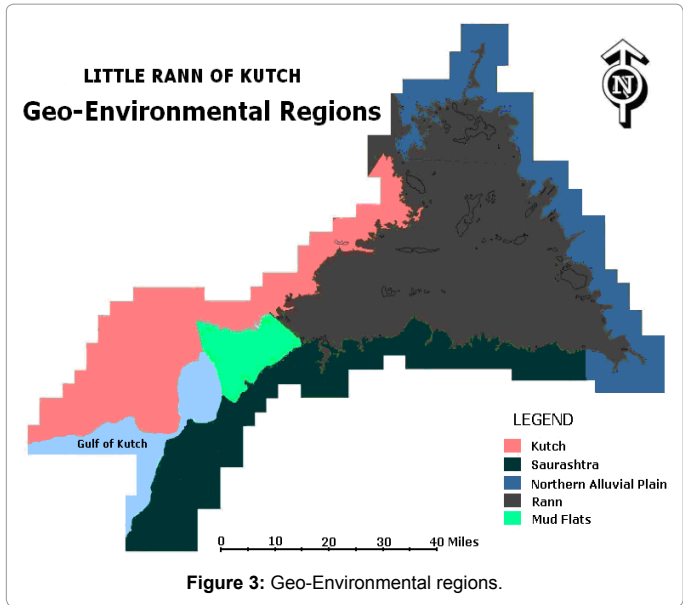
Maidio, Bokano, Khijdo, Gegadi, Thor, Dhara, JhinjwoandKerdois the common vegetation of this zone. Distributional pattern of the scrubs, grasses advocate the nutritional richness in the area. Increasing nutrient availability is generally considered as the norm for grasslands. Field tests and sample analysis clearly indicates the higher moisture with lesser salinity in the grasslands. Soil moisture is recognized as one of the principal determinants of grassland [12] and is also true with this part of study area. The recurrent vegetation happens to be in the Rann grassland are *Cressa Cretica* and *Aeluropus Lagopoides*, whereas, *Cyperus* and *Scirpus* grew only during the rainy season. Soil characteristics of grassland along the fringe of Little Rann resembles to its larger part with only difference being covered by grasses. Management in the region needs to start with the afforestation, all along the margin of Little Rann to check further desertification. Developments of Pisciculture, fodder & animal husbandry & dry farming have a greater scope in the area. Harvesting of rainwater through bunding is possible only in certain areas, with reference to local relief. Comparatively, this part of area has more of biodiversity and is at much better place on ecological account.

### Dry Rann depression

The alternation of aridity and wetness in the area has facilitated the process of paedogenesis. Dry Rann depression is a typical example of erratic soil moisture regime. Dry Rann depression is characterised by deep dark colored soil with a higher proportion of clay in it. The dominance of clay further increases towards the west, towards wet Rann. The soil type shares every characteristic of vertisols, which supports grassland and deep rooting trees. However, the area is devoid of vegetation because of unfavorable soil salinity and climatic characteristics. The basic aspect of rann soil is swelling and shrinking during wet and dry seasons respectively (Figures 5 and 6) Intensity of cracking and leaching of carbonates and salts is directly related to moisture availability (Figures 7 and 8). Vertisols may develop in situ or out of denudational act. These soils are diverse in terms of its

S.no	Geomorphic units and elevation	Surfacial Expression	Land use	Management Measures
1	Fringe Area 10 feet (west of Maliya) to >100 feet (north-west of Dhrangdhara)	Gently sloping plain frontiers joining the Rann area. The zone is rilled & gullied by local small seasonal streams.	Covered with drought resistant vegetation, more dense in the eastern and southern side, while western fringe is sparser. Grasses grows in the marginal area of Rann for a few months in a year. Irrigated farming, Sandstone mining in Dhrangdhara	Afforestation all along the margin to check desertification, development of Pisciculture, fodder & animal husbandary, dry farming. Harvesting of rain water through bunding.
2	<b>Dry Rann</b> 7 feet (foot of Wasraj bet) to 25 feet (north of Jhilandhan)	Monotonous plain, covered with brine, clay and windblown sand.	Completely barren, Extraction of salt is carried out during dry period.	Reclamation of area and storage of water at small scale can be done by making bunds.
3	<b>Western Wet Rann</b> <7 feet above MSL	Monotonously plain with very high density of creek channels	covered with mangroves except in south eastern part	Check on deforestation & impetus on mangroves plantation, Pisciculture & Judicious use of resources
4	<b>Islands</b> 30 to 179 feet above MSL	Hard superficial character. Sandstone with flat topped basaltic rock	Thin grasses with short stunted Acacia Tree.	Contour vegetative hedge, fodder, fuel etc.

**Table 1:** Landscape Ecological Planning Measures. after Gupta & Ansari (2012) modified.



origin and may be related to riverine and lacustrine alluvium, igneous, sedimentary and metamorphic rocks of basic nature, limestone, shales and calcareous rocks etc [13]. The development Rann soil is the result of denudational processes that is deposition of alluvium brought by the rivers from Saurashtra's basaltic region. The Rann sediment is exposed to alternate shrinking and swelling, causing self-mulching and thereby, development of extremely deep horizon of vertisols. Black colour of Rann sediment is evident to the depositional processes from the surrounding basaltic zone, exposed to erratic droughts and floods. The characteristics of Rann sediment & non availability of moisture do not support the vegetation. Relatively this part of study area has less of soil moisture due to the distance between the sources of water [14]. Field check revealed that the soil has very poor water mobility within the pores although there was sufficient moisture. Poor permeability of the Rann sediment restricts the movement of air, water and nutrients accessibility for plant. The alternate contraction and expansion of the soil results into the rupture & breaking of roots of the vegetation. The parched surface with deep cracks does causes foot injury to the fauna of the region.

**Western wet Rann**

Western wet Rann is more like a gulf, endowed with variety of

ecosystem such as: sand dunes, intertidal zones, salt pans, mangroves, creeks etc. Aspects of Mangroves and Salt pans ecosystem has been discussed, being approachable. This region is characterised by the network of creeks and alluvial marshy tidal flats. There are three main creeks namely Hansthal, Nakti and Kandla. River Banas, Rupen and Saraswati carry 140 m<sup>3</sup>water annually to the Little Rann of Kachchh causing flood during southwest monsoon period, wherein more of water is saline wind driven water towards the east causing a short term connection with the creeks. The area receives minimally low amount of freshwater. Since the evaporation exceeds precipitation and therefore salinity goes higher than 35-36 ppt. The drainage of brine from salt pans is the reason for excessively higher salinity. Salinities upto 50 ppt. is a common characteristic in the Little Gulf of Kachchh. The geomorphology, particulate matter, wave action and associated littoral sediments together with biological and physio-chemical characteristics impart a unique ecological setup in the area. A variation in the salinity is the distinct feature of salt pans, an enclosed system of tidal water and therefore is exposed to a variety of stress and disturbances. Stability and simplicity being the unique feature of salt pan manifests itself through a very less number of species. Although, salt pans serve as feeding grounds for a variety of resident as well as migrant birds, the number of biodiversity is indirectly related to the amount of salinity.

### Islands (Bets)

In general, the islands are rocky in its surface characteristics and is also same with Jhilandar bet, with fragmented boulders of sandstone lying all along the sides. The flat top surface of bet resulted into the accumulation of a good thickness of soil in situ. The Jhilandar bet is dotted with ample of vegetation ranging from the grasses to the Prosopis Juliflora and other shrub xerophytes. This bet is named so, owing to the presence of Jhil (lake) which remains alive around the year. This Island resembles to the oasis in the middle of Rann, with Peoples, livestock & vegetations. There are still some other islands which are barren and rocky. There is much variation in the drainage aspects of island related to slope element (Figure 9). It also reflects variation in surface texture & moisture. Foot zone of islands shows mud accumulation and remains wet for long. The landscaping of islands with scope of moisture availability can be thought of by taking some conservation method such as vegetative hedges & contour. Salvadora plantation, initiated by Forest Department of Gujarat in 1991 did not go well because of rocky surface & aridity at Mardha, Nanda & Shedwa islands. Whereas Khijadiya, Maharajawali, Pancham, Miyan, Andheri wen and Dhut Bets have a good canopy of vegetation.

### Priorities identified soil protection

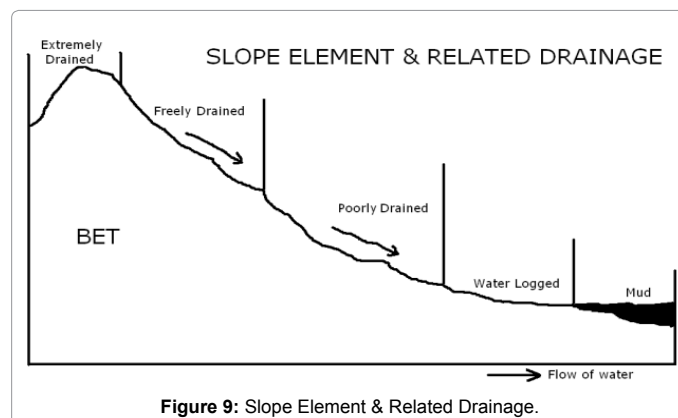
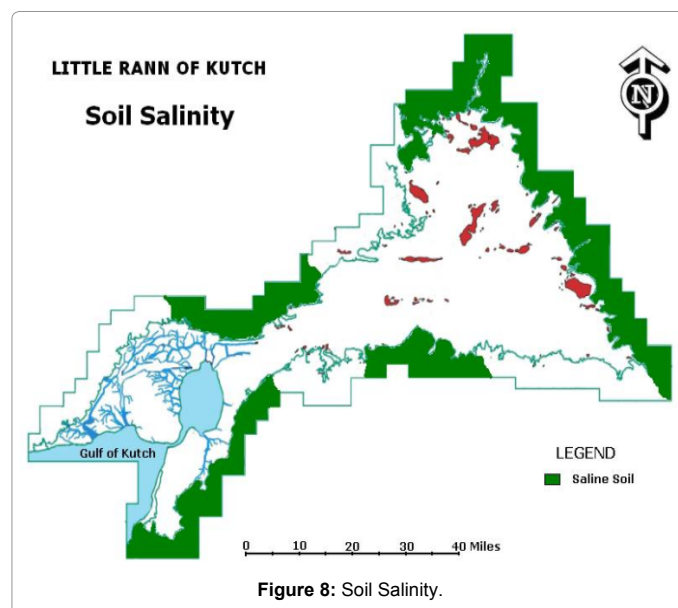
The study area being in a semi-arid climatic condition suffers from the aridity and desertification. Also, the soil being Vertisols are underutilized because of difficult physical properties. The fringe area lying around the Little Rann of Kutch is used in the form of irrigated field with marginal production is very much susceptible to the desertification and in many areas the top soil is covered by windblown dusts and sands. The streams lying in the area have eroded the surface through gulling. The soil is also being destroyed in the process of salt mining and grassland fires. There is also a huge area, which is fallow and abandoned area. The soil surface in the bet areas are exposed to the erosion through runoff during monsoon. The fine particles are also blown through the winds, degrading the soil. The mining activity at large has changed the land cover. Apart from the deforestation, the mangroves also die out because of increasing salinity in the area.

The possible measures which could be taken in order to protect soil are:

1. Classification of soil and creation of soil maps at adequate level.
2. Sustainable management and increase in the scrubland and mangroves, which will reduce the erosion.
3. Fire prevention and fighting.
4. Slope protection and flood control keeping in mind the environmental impact.
5. Implementation of strict environmental laws.

### Sustainable management of water resources

Since the population exists only in the marginal area the priority is given to the fringe zone, to understand the nature of problem. However, few houses were also seen on the bet. To start with the sustainable management of water resource, adaptation of water protection plan is prerequisite. There is a need to monitor the distribution and utilization of groundwater and surface water in order to reduce the waste. Villagers are inadequately equipped with the irrigation techniques so to minimize the water requirement. Since the water is limited in the area and therefore the waste is also. Household sewage water is directly discharged in the kitchen garden. However, there is ample of scope to develop the harvesting of rainwater through making of bunds across the streams. There is a need to develop techniques for using as much as



possible of the water received while also providing surface drainage to avoid water logging. Man-made micro relief patterns can also improve surface drainage include convex beds, ridges, narrow beds and furrows, and broad beds and furrows.

### Land-cover restoration

Looking to the ecological problems related to the soil and water resources, the identified measures to be taken in the area are:

1. To recover the soils which are damaged by erosion, desertification salinization, mining, deforestation etc.
2. Reclamation of saline waste areas and margins of Rann through checking the flow of saline water at small scale.
3. Transformation of environment through plantation and nurturing of trees particularly in the furrows rather than on the beds and ridges, which will also act as water harvesting tool.

### Conclusion

Little Rann of Kutch, an example of the confluence of both arid and semi-arid regions is characterized by the climatic condition with insufficient rainfall to sustain vegetation around the year. The recurrent drought and flood make the ecosystem of the area more fragile. The entire study area (The Little Rann of Kutch) falls under the zone of northern semiarid climate, which is contiguous with the Thar Desert. The Little Rann of Kutch is phytogeographically interesting, since it is located at the junction of several phytogeographic provinces and is composed of diverse floristic elements. The study area experiences a very high ambient temperature at one point of time while it gets flooded by both the tidal water ingress and fresh water poured by the seasonal rivers during the monsoon season. During summer season the water recede and evaporate, they leave behind a crust of halite and gypsum crystals which grow in the clay and sands. The patterns of distribution of biotic elements & human ecology are at large explained on the basis of bioclimatic conditions prevailing in the area. Anthropogenic activities such as pastoral, salt mining & dry farming not only advocates for the climatic characteristics of the region but also reduces the vegetal cover, subsequently, the soil is lost through erosion and thus the environmental degradation results. Semiarid ecosystems are by far most fragile ecosystem because of ever increasing pressure of man, being lying at the periphery of dense human settlement. Conditioning of such areas are related to proper understanding of

biotic & abiotic elements such as soil type, its particle size, hygroscopic co-efficient, water holding capacity, plasticity of soil etc. An attempt has been made in this paper to understand the causal chain of actions that leads to desertification considering the environmental impacts of past actions and thereafter, developing valid strategies & methods of restoration on the basis of petrography analysis. A systematic account of the ecological resource has been carried on a regional framework in order to propose, case sensitive strategies for protecting biodiversity, resource management and to improve quality of life in semiarid lands.

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