

Chapter-7

SUMMARY & CONCLUSION

A sincere attempt has been made in order to fulfill the aim and objective of the research work under taken. Proper attention has been given to see that the work did not deviate from its objectivity.

The aim of the research work was to assess the impact of geomorphic processes in transforming the landforms of the area, to study the spatial & temporal morpho-dynamics (changes, dominance & intensity of processes at work in different seasons) with respect to the environmental factors of Topography, Climate, inundation pattern, Parent material and Vegetation in the Little Rann of Kutch. The study also focuses on the morphological & ecological component of the area & to fabricate its relationship i.e., Morpho-ecology that will help in the management and smooth functioning of the ecosystem.

Whatsoever may be the geological history of the study area, it is clear through the field visit that geomorphic processes operating in the study area have close relationship with the present configuration of the surface features. Beyond any doubt, once upon a time the study area was a shallow sea finding its continuity with the Gulf of Kutch to the south and Indus, Luni and other paleo-channels to the north. Gradual upliftment and shifting of Indus has imparted the present condition to the Little Rann of Kutch.

The types and intensity of geomorphic processes in the study area has painted the area with different surfacial characteristics. Different type of geomorphic processes operating in the parts of study area has also formed a strong base for its classification.

The study area is classified in line with the Passarges classificatory scheme and considering various parameters such as geo-ecological balance of the area, considering prevailing climatic, geomorphological and ecological condition. Four geomorphic regions has been identified in and around (two miles of buffer and extending upto Gulf of Kutch) the Little Rann of Kutch .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.

The fluvial erosional works are relatively most prominent in all along the fringe area of the Little Rann of Kutch. However, the intensity varies from eastern fringe to western and southern to northern. The eastern and southern peripheral zone of the triangular Little Rann of Kutch is relatively more exposed to the fluvial erosion with an exception of the area where river Saraswati drains itself in the Rann. Otherwise the entire western fringe is marginally susceptible to the erosional work.

The climatic characteristics of the fringe area is no different from that of adjoining area of Little Rann of Kutch, with only difference in terms of available moisture discharged by the streams and also several small streams being collected in ponds, lakes and small reservoirs. Since the area has a flat topography and streams are seasonal and therefore, the streams do not have well defined channel. Almost all streams draining this area is guided by local slope element and therefore are parallel in their orientation. The flat characteristic of the area is also manifested through a very high density of streams. These streams and streamlets have rilled the entire fringe area. The fringe area doesn't have any structural control over the geomorphic processes as they are older coastal dunes and unconsolidated silty sand and silty clay.

The eastern and southern fringe falls under the semi arid type of bioclimatic zone, whereas western fringe together with the Little Rann of Kutch falls under the desert Kutch zone. The fluvial work along the eastern and southern fringe is more pronounced than the western fringe. The streams draining western fringe have a very less catchment area and are of very short length.

Except for the lower half of eastern and southern zone (excluding Dhrangdhara), the entire fringe area is drought prone area. Geomorphologically, the lower half of eastern and entire southern fringe is same, that is formed of unconsolidated silty clay and coastal dunes. The eastern and western upper half fringe is characterized by elevated and uninundated silty sand. The lower western fringe is characterized by old and young dunes. The ground water salinity is high that is, greater than 2000 parts per million in the entire fringe area with an exception of the areas drained by river Rupen, Banas and the Dhrangdhara.

The Rann actual has been divided into dry and wet Ranns. The drier Rann lying to the western part are relatively drier because of distance from the sea and local relief. Mirage effect is much pronounced in this area. This area gets submerged under water only during rainy season. Whereas, wet Rann remains wet for longer period and even throughout the year for it is influenced by the sea. The sediments here are much bulky and impermeable than its fringe counterparts. The western part is covered with brine clay and wind blown sand, providing an ample scope for salt mining. Geomorphic processes are least active in the western part of Rann. The aeolian processes seem to operate during the dry period leading to the rise of dust particles through winds and moves further towards land area. During monsoon season no significant deposition or erosional activities can be seen except for the soil swell followed by the shrink and deposition of

salts making it a white desert. The amount of suspended salt in the area is so much that even breathing gives a salty taste.

The western Rann is a wet zone with variation in the amount of moisture at different locations. Moisture is relatively very high towards the sea making the soil completely saturated with water. The surface shows puffed condition due of excessive swell. The excess of water in the area owes to the availability of high density of creek in the entire western part. Marine processes are dominant and are very active, providing almost no space for fluvial and aeolian processes. Presence of creek and continued supply of saline water has paved the way for development of saltpans and related activity.

The bets are the islands characterized by their higher relief which is a very prominent landscape in the midst of the Rann. They appear to be island in the white desert during dry period and also during rainy period being surrounded by saline water. The islands solely differ from the surrounding being having altogether a different relief, surface configuration and landcover. Islands show a very thin development of soil profiles owing to the continuous removal by erosional processes. The island rises sharply from the ground surface to form mounds, having flat top characterized by hard surface of sandstone and flat top basaltic rocks. The surface configuration differs from island to island, some showing good development of soil and some are covered by stony waste. Island like Jhilandhan have many lakes on it and therefore rich in the vegetal cover.

The samples collected from the field were tested in the field as well several tests were carried out in the laboratory. All laboratory tests except for plasticity and grain size analysis were done personally. In order to have a better understanding and generalization of the area wide array of samples were tested. While collecting the samples special care was taken

in order to maintain the natural moisture content. The samples could not be collected from the field during rainy season that is when the soil gets saturated naturally and neither the hygroscopic test were done out of the moist soil directly from the field. To check the hygroscopic coefficient of soil samples were kept in the open shade and test were done in correspondent with the humidity percentage of the air and the weight of soil at that point of time. Movement in the field was also restricted to certain part of the year.

Areas with similar characteristic are the common phenomenon of semi arid area with adequate amount of rainfall to carry out the self mulching processes. The intensity of fluvial erosion relative to the available water is much higher owing to the bare ground especially during the first phase of monsoon rain and spasmodic rainfall. The flat topography of the surrounding area has imparted to the development of numerous small streams in the fringe all along the Little Rann of Kutch.

Visual observation suggests that the Rann sediment is much compact as compared to the fringe zone. Also, sample test reveals that the bulk density of the Rann sediment is much higher. Bulk density is referred as the deformation of soil, higher bulk density of the soil means higher strength of the soil. Rann soil lacks in pores which are created by plant roots or burrowing creature and thereby restricting the free movement of water and air through the pores. Upto a great extent the pores determines the soil's physical as well biological properties. There are other indirect effect of such soils as for example; reduction in the infiltration capacity, resulting into surface run-off, flooding, erosion and leaching of soil, also plants growth are retarded because lack of required air and nutrition. Such soils limit the root growth and thus making it vulnerable to disease and uprooting. Soils with higher bulk densities as that of fringe zone results in the gradual decline of production and increase in water logging. Subsoil compaction is

considered to be the hidden form of soil degradation. The impact of compaction is severe during the years with extreme climatic condition.

The results of the various test conducted with the sample sediments are as follows:

- (viii) The proportion of Clay is dominantly very high as compared to other sediments. Proportion of clay is as high as 60% in the Rann area (7 Km. west of Khadaghoda) while it is low upto 5% along the flood plain of river Rupen in the fringe area.
- (ix) The plasticity index is very high in the Rann sediments, reaching upto 61 close to Surajbari Bridge, while it is lowest (14) again along the flood plain of river Rupen.
- (x) Moisture content during the fair weather condition was 30% (highest) in the sample collected from close to the Surajbari Bridge (creek area) and lowest (5%) in the sample collected from Zainabad.
- (xi) A very high Porosity (29%) turned out in the samples collected from the flood plain of river Rupen whereas, lowest (5.3%) was in the sample collected from the area close to Surajbari bridge.
- (xii) Highest surface salinity (12094 ppm) was recorded in the dry channel bed, midst of Rann. Lowest among the samples was 281.6 ppm along the bank of streams between Patadi and Savada.
- (xiii) There is no significant difference in Natural volume and Compact volume. The maximum and minimum difference is 0.8 and 0.0 Cm^3 respectively.
- (xiv) Water holding capacity also turned out to maximum (0.836 ml/gm) in the sample collected from the area close to Surajbari Bridge and lowest (0.380 ml/gm) in the sample of Zainabad.
- (xv) Hygroscopic absorption capacity (Water absorbing capacity) at different humidity level was all time maximum in the samples collected from eastern dry areas of Rann close to periphery while it was lowest in the Bet sediment.

The quantitative results and physical observation when reviewed and correlated, discloses following important properties of the sediments of the Little Rann of Kutch.

(i) The soil is compact and firm.

(ii) The field moisture is higher and it increases with the depth.

(iii) Process of infiltration is much slow as compared to the sediments of the fringe zone.

(iv) The sediment is impermeable.

(v) Rann sediment shows hyper sensitivity to the humidity present in the air. It is evident from the field and laboratory test that the Rann soil becomes moist even with the slightest of moisture in the air, through hygroscopic absorption. Hygroscopic absorption for a given relative humidity increases with increasing amount of clay associated with salt.

The causative factors for accumulation of salt in the sediment are:

(i) Poor and limited vertical or horizontal drainage conditions

(ii) Dynamic force regulating movement of water;

(a) Imperceptible Relief element that regulates the surface runoff.

(b) Dimension of pores that accomplishes Capillary action.

(iii) Negative water balance that is, when evapo-transpiration surpasses the amount of precipitation.

Factors that emerge to control the infiltration capacity of Rann sediment includes:

(vi) Amount of water applied

(vii) Available field moisture capacity

- (viii) Moisture conductivity of the upper and subsequent lower horizon of the profile and thereafter
- (ix) Texture and structure of the various sediment horizon

The entire area with a climatic condition varying from arid to semi-arid is either in the process of desertification or is already a desert. Fringe zone and the bet zone is the vulnerable zone while the Ranns have all the characteristics of desert. There are substantial difference in the factors, processes and forms of desertification in different locations.

This area is temporarily inhabited and gives sustenance to the peoples working in the salt industries. Despite having (worked out, 1970-94) co-efficient of variability of rainfall less i.e. 14% (Agricultural Handbook, Gujarat, 2000) (relation; higher the variability lower is the reliability; 20% is considered to be best suited for dry farming), the area cannot be cultivated at its best because of the fact that area is devoid of quality soil. There is a need for plantation of the drought and salinity resistant vegetation along the eastern margin of the Little Rann of Kutch so as to check the further desertification and to control surface runoff. Animal husbandry can be carried out in the area considering that there should not be over increase in the quantity, the improved quality of animal has to be the key thrust which otherwise would lead to the exhaustion of vegetation or situation go beyond the recovery of the regeneration capability. Conservation, protection and rehabilitation of vegetation are required in the area. This area becomes a seasonal shallow brackish water lake for 3-4 month in a year. During this period the salinity fluctuate between 0-37 ppt. and PH value is reduce to 7.6 from 8.2 due to influx of fresh water and incoming sea water on the mud flat. Large amount of terrigenous deposits accumulates in the seasonal lake providing good nutrient to the fishes.

The study reveals that the visual interpretation of the toposheets and imageries coupled with collateral and field checks information can be well used for delineating and assessing the ecological and economical characteristics and capabilities of different geomorphological units. The identified geomorphic units of little Rann of Kutch is confronting several problems related to its geomorphology and human interference which is largely regulated by an integrated complex of socio-economic & bio climate interrelationships. Also, the resource of the area is being subdued by the ever increasing population & in a state of destruction if it is not checked in time.

Priorities of the study area are:

- (i) Soil protection
- (ii) Sustainable management of water resources
- (iii) Land-cover restoration

Keeping in mind the long term development of the study area following problems for further research has been identified.

- (i) Land classification and capability for different land use.
- (ii) Hydrological aspects, dealing with water budget, moisture balance of soil.
- (iii) Assessment of soil erosion by wind, water and also marine forces particularly along the coastal areas and its control.
- (iv) Microclimate studies to correlate climatic variables, soil and associated flora and fauna of the region.
- (v) Carrying capacity of the land to be assessed in order to regulate the human and cattle population.
- (vi) Land-cover and Land-use pattern of the region