Chapter-6

MORPHO-ECOLOGICAL PLANNING AND MANAGEMENT

Arid and semi arid regions are characterized by a climate with no or insufficient rainfall to sustain vegetation. The patterns of distribution of biotic elements are at large explained on the basis of bioclimatic conditions prevailing in the area.

Spasmodic storm water drainage, its regulation and water resource management is an important phenomenon to deal with in the semi arid regions. 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 amount of moisture recharge in the ground depends upon the intensity and duration of rainfall and the surface configuration of the ground.

The entire study area falls under the zone of northern semi arid 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 vegetation of study area is similar to the Sindh (Pakistan) and North-west Rajasthan.

The recurrent drought and flood make the ecosystem of the area more fragile. Anthropogenic activity in the area has reduced the vegetation cover against marginal cropping, grazing land has been over used and

subsequently, the soil is lost through erosion and thus the environmental degradation results. The programme for morpho-ecological management must be based on the survey of historical land use pattern and potential productivity of the region, which is a difficult task to asses.

Looking to the condition of the vegetal cover in the Rann, Champion and Seth (1968) classified the vegetation of Little Rann of Kutch as Rann saline thorn Scrub and Tropical Euphorbia scrub at its degradation stage. Gupta and Saxena (1971) 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 (1972).

Joshi (1959) points out the earlier records of mesquite Gando Bawal (Prosopis Juliflora) 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 (1993) 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 type's 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, there 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.

With an understanding of soil's physical properties and its relation to soil moisture, one can take a better morpho-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 soil is much denser and has reduced the biological activity, porosity and permeability. Compaction has reduced the water infiltration capacity and has increased the rate of erosion by accelerating run-off particularly in the eastern fringe zone.

The water holding capacity of the Rann sediment is higher than the fringe area and the bet area because of the higher content of finer particles like clay and silt in the soil. However, the Rann could not support the vegetation because of other factors.

In the resource crunch and hostile climatic and geomorphological features in Little Rann of Kutch, the human population density according to 1981 census is around 63.77 persons per sq. km., solely dependent upon the salt industries; some 603 villages were identified along the fringe of the Little Rann of Kutch by Sinha (1993).

Land use of the area with reference to the soil type is dominantly grazing by sheep, camel and cattle or dry land agriculture as in most countries with vertisols development.

At present the Little Rann of Kutch and its surrounding fringe is confronting & combating with multidimensional environmental degradation problem such as growth of population, land use changes, deforestation of mangroves, deforestation, reduction in wet land area, decrease in pastoral land & land degradation due to wide spread salt mining (Map- 6.1).

It is apparent from the preceding chapter that the study area had some distinct variation in terms of its geomorphological characteristics and

the land-cover at micro-level. And, on the basis of those variant the study area has been divided into various regions.

After a thorough analysis of the identified geomorphic unit, 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 considering prevailing climatic, geomorphological, ecological and economical condition (Table 6.1). The detail study of the area unveils the problems associated with it and also reveals its physical and ecological capabilities for restoration and landscape management.

6.1 FRINGE AREA

Referring to the discussion pertaining to this region in the previous chapter, it is clear that this area is not as extreme as that of the 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 in this part of Rann goes upto 3 feet during monsoon season. In terms of its surfacial expression, it is gently sloping plain frontier joining the Little Rann of Kutch. This zone is rilled & gullied by local small streams.

The soil in the fringe area has relatively less compact soil as compared to the Rann sediment and therefore offers better permeability capacity and that is why vegetation can be seen. Visual inspection and laboratory tests states that the presence of sand in the soil is more in the northern, northwestern and along the bank of river Banas and Rupen. Such soils are deficient in plant nutrients; they leach out easily with rainfall. Sandy soils are less productive than silts and clay.

The marginal area being higher than the Rann depression did not get inundated and is covered by Prosopis scrubs. The numerous stream which that passes through these scrubland deposits pebbles, sands, silt and clay in this zone. Such deposits are found in close proximity to the fallow land and the croplands. The soils in such environment are sandier than any other areas of study. *Bawar, Bordi, Aawad, Pilu, Sankhpushpi, Maidio, Bokano, Khijdo, Gegadi, Thor, Dharo, Jhinjwo and Kerdo* is the common vegetation of this zone.

Distributional pattern of the scrubs, grasses advocates the nutritional richness in the area. Increasing nutrient availability is generally considered as the norm for grasslands.

Vegetal association of an area is the expression of allogenic processes and autogenic processes being carried out in the area. Le. Houerou (1981) describe autogenic succession due to micro-environmental effects of the vegetation itself or to the effect of the fauna and allogenic succession due to geomorphic processes of gliptogenesis and sedimentation.

Soil moisture is recognized as one of the principal determinants of grassland (Dargie and E.L.Demardash1991), and this is true with the peripheral Rann grassland as well. Ground check, field tests and sample analysis reveals that the availability of moisture is higher and lesser salinity in the grassland than the other areas at both ends.

The perennial species that grows in the Rann grassland are cressa Cretica and Aeluropus Lagopoides, whereas, Cyperus and Scirpus grew after the area gets inundated during monsoon. The saline grassland resembles to the depression of the Little Rann of Kutch with only difference of having grasses growing on them.

6.2 DRY RANN DEPRESSION

The soils present in the area are deep dark in colour with a very high proportion of clay in it (a characteristic of vertisols), increasing towards Rann depression from the surrounding fringe area. Such soil system supports grassland and deep rooting trees. However, the Rann do not support vegetation because of adverse climatic characteristics and soil salinity. The seasonal variation in the climatic characteristics, basically rainfall and temperature of the area has facilitated the development of vertisols. The entire study area is typical in terms of erratic soil moisture regime. The very basic attribute of such soil is shrinking and swelling during wet and dry seasons respectively. Generally, higher rainfall results in higher intensity of cracking and increased leaching of carbonates and salts.

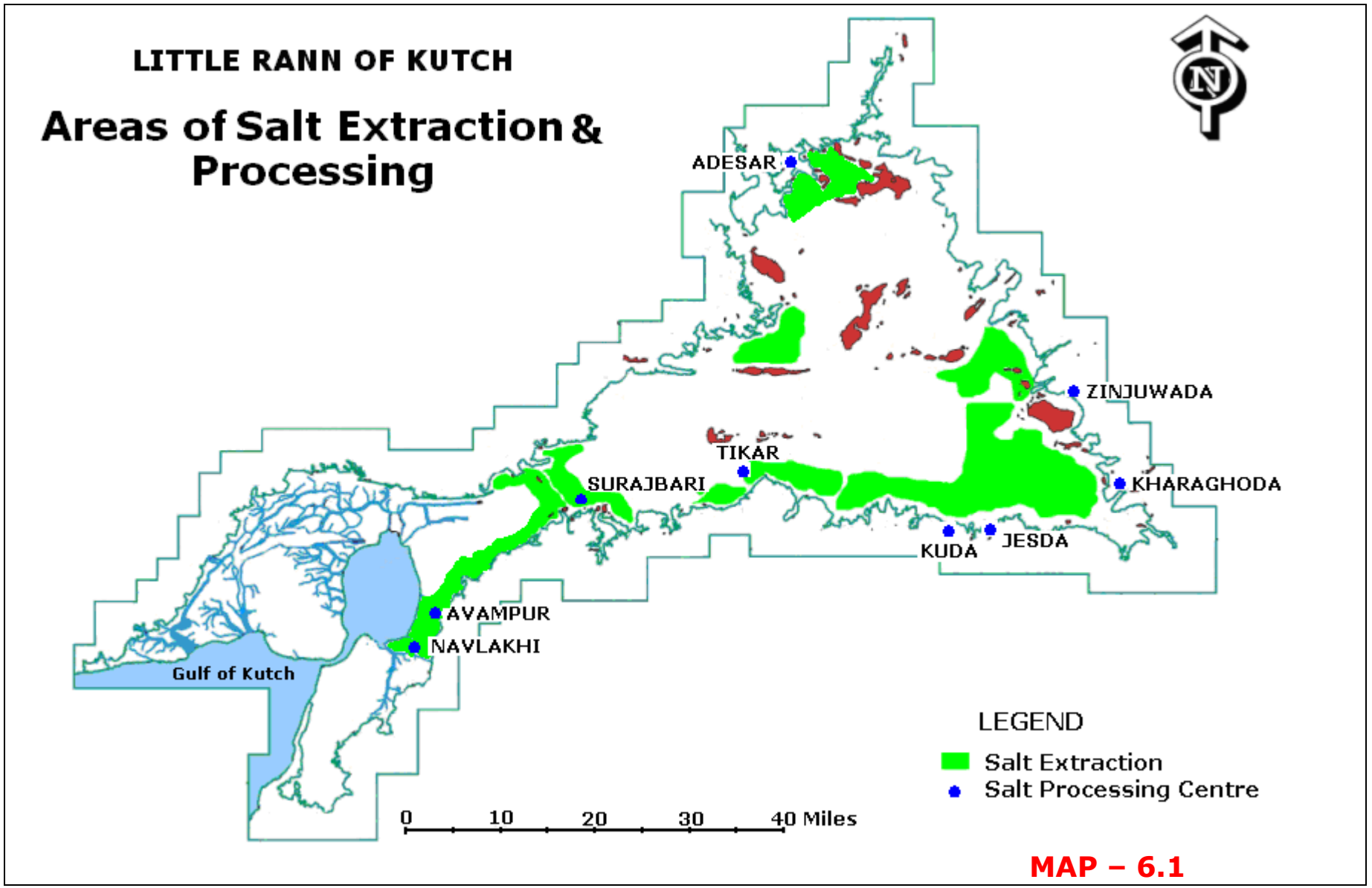
Vertisols develop out of broad variety of parent material as for example riverine and lacustrine alluvium, igneous, sedimentary and metamorphic rocks of basic nature, limestone, shales and calcareous rocks. Such soil may develop in situ or may develop out of alluviums. The development of vertisols in the Rann has result out of the alluvium deposited brought by the rivers from surrounding basaltic regions, mainly Saurashtra. This soil has developed on young landscape on a very old geomorphic surface of Indian peninsula.

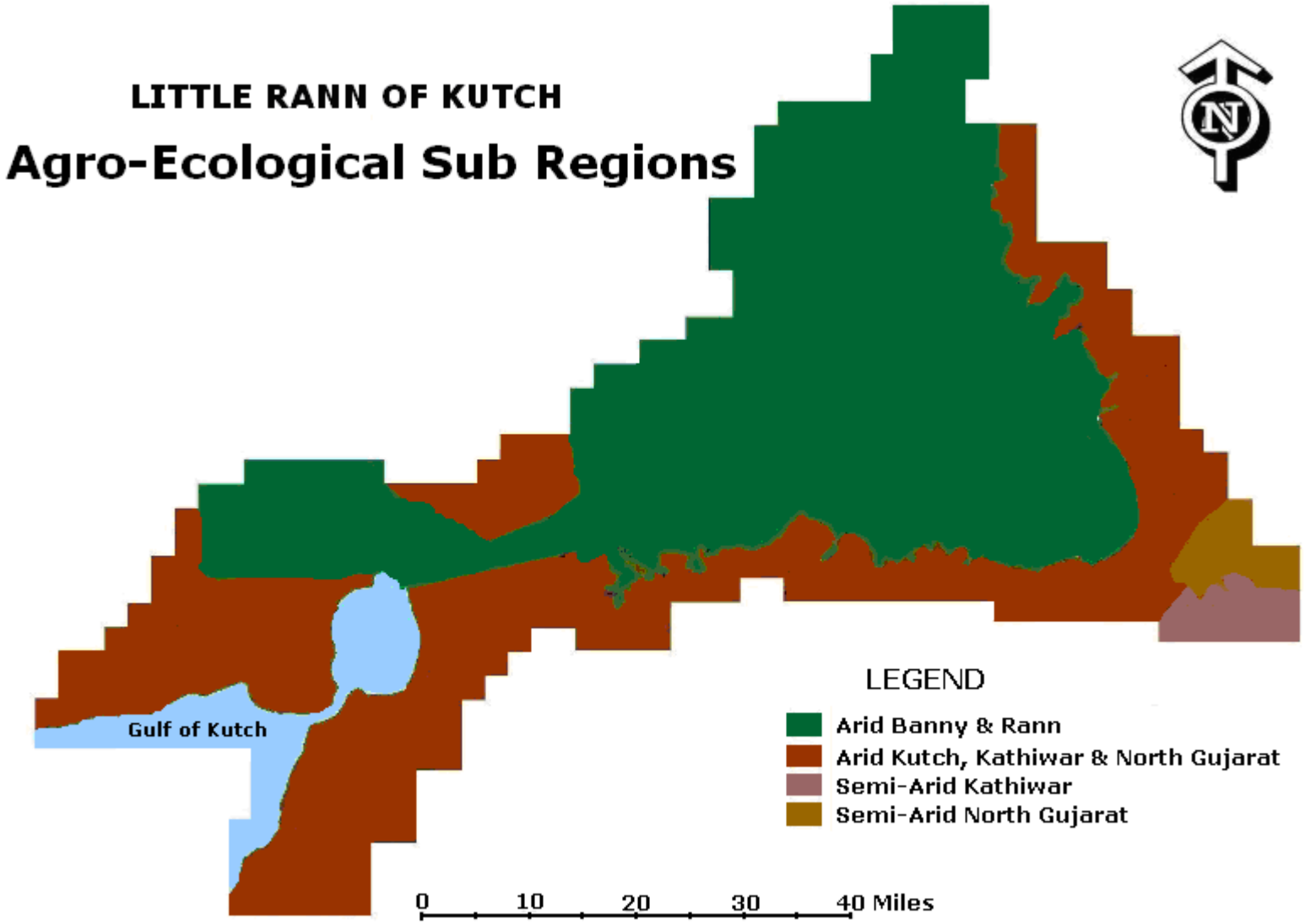
Alternate shrinking and swelling of Rann soil (clayey soil) causes self-mulching. The consistent mixing of the soil through mulching leads to develop extremely deep horizon of vertisols. Rann sediment is formed of basalt and that is why it is black in colour. They are formed in climatic zone which is seasonally humid and subject to erratic droughts and floods. The very characteristics of vertisols do not support the vegetation. They are

rather covered by grasses or thin stunted bushes, depending upon the prevailing climatic conditions.

Comparatively this part of study area has less of soil moisture owing to the distance between both the source of water that is inland and marine. During the field check the soil showed a very poor mobility of water within the pores though the moisture was sufficient enough to show, especially in the furrows within the Rann.

Since the permeability of the Rann sediment is lesser and therefore it restricts the movement of air, water and nutrients availability for plant uptake. The continuous contraction and expansion of the soil causes roots of the vegetation to be stretched and thus broken. Very often the cattle and other fauna in the area also suffers foot injury caused due to due falling in the deep cracks.


LITTLE RANN OF KUTCH
Areas of Salt Extraction & Processing
ADESAR
ZINJUWADA
TIKAR
SURAJBARI
KHARAGHODA
KUDA
JESDA
AVAMPUR
NAVLAKHI
Gulf of Kutch
0 10 20 30 40 Miles
LEGEND
Salt Extraction
Salt Processing Centre
MAP – 6.1



Source:Degraded Lands in Gujarat, Gujarat Ecology Commission (Modified)

MAP - 6.2

6.3 WESTERN WET RANN

Being closer to the Gulf of Kutch, the western most part of study area is more akin to the gulf. Generally, such areas are endowed with a diversity of natural ecosystems as for example intertidal zones, salt pans, mangroves, sand dunes, creeks etc. Salt pans and mangroves being approachable and more explicit in the study area, is given space for discussions.

There is a network of creeks and alluvial marshy tidal flats in the interior part of the Gulf. The creek system consists of three main creeks namely Nakti, Kandla and Hansthal. The Little Gulf of Kachchh is inter-connected through many other big and small creeks. The three desert rivers, Banas, Rupen and Saraswati, carry annually 140 m^3 water to the Little Rann of Kachchh that gets flooded during the southwest monsoon period establishing short term connection with the creeks at the head of the Gulf. The creek receives negligible freshwater inflow during the dry season. Hence, the evaporation exceeds precipitation leading to salinities higher than that of typical seawater (35-36 ppt). The higher salinities may also result due to the drainage of brine from saltpans and higher evaporation rates in the adjoining creeks. Thus salinities upto 50 ppt. have been recorded in the Little Gulf of Kachchh. The fresh water run off during monsoon considerably dilutes the seawater in creeks.

The intertidal zone lying between land and sea is consisting of particulate matters. The wave action and associated littoral sediments impart a unique environment to the ecosystem. The geomorphological, biological and physio-chemical features play an important role in determining the ecological setup of the area.

Saltpans are distinct enclosed system of tidal water. They are exposed to a variety of stress and disturbances which manifest it through variation in the salinity. The unique feature of the saline ecosystem is its stability and simplicity. The saline ecosystem is simplified because the number of species is less. Moreover, number of species is indirectly related to the amount of salinity. These saltpans serve as feeding grounds for a variety of resident as well as migrant birds.

6.4 ISLANDS (BETS)

The Jhilandar bet is rocky in its surfacial characteristics, with flakes of sandstone spreaded mainly all along the sides. The relatively flat top areas of the bet have a good thickness of soil. There is ample of vegetation on the bet ranging from the grasses to the Prosopis Juliflora of considerable height. This bet is named after the lakes (Jhils) which remains filled with water through out the year. A few families dwell on this island. Even the cattle are also brought from the near by fringe areas for grazing. The islands are the only area in the midst of the Rann depression having vegetation, resembling to oasis in the desert. However, not all islands have vegetal cover on them.

The landscaping of these geomorphic units can be done by taking conservation method like a development of contour, vegetative hedges, fodder, fuel wood, social forestry etc.

Discussions with the natives of Vanod village revealed that Andheri wen, Maharajawali, Khijadiya, Miyan, Pancham and Dhut Bets have Suaeda Fruticosa as the dominating shrub. These islands are covered with wind blown particles. The island such as Mardakh, Shedwa, Nanda and Jhilandhar are rockey in its surfacial characteristics.

In 1991, Salvadora plantation was carried out by the Forest Department of Gujarat, but could not survived due to the extremity of climatic condition.

6.5 MANAGEMENT ISSUES & CHALLANGES

Experience of ICRISAT's (International Crops Research Institute for the Semi-Arid Tropics) in semi-arid peninsular India has shown that with suitable management scheme, the productivity of vertisols can be significantly increased. They have proved that Vertisols have a much greater potential productivity under rainfed conditions than was thought.

Studies have shown that when irrigation is available, crops such as cotton, wheat, sorghum and rice can be grown. Specially wet paddy can be grown on vertisols because these soils are almost impermeable when saturated. Rainfed farming cannot be thought of in the area because vertisols can be worked only under a very narrow range of moisture conditions as they become very hard when dry and very sticky when wet. Vertisols soils are rich in phosphorus and manganese, which is responsible for its dark colour. However, with increasing moisture, the amount of mineral content within them may wash out.

Cyperus and Scirpus grow in the depression area where there is mixture of clay and salt. Blumen and Echinochloa Colonum grow in the area having puddles of fresh water. In the area having sandy and gravelly soil, Boerhavia, E. Ciliaris and Corchorus grows up and gradually replaced by Aristida. Almost all the species growing in the area are good soil binders.

In the words of Roberts (1991), "For several decades planners have based permanent land use systems on two simple principles:

(i) Use each portion of land according to its potential to produce.
(ii) Protect each portion of land according to its susceptibility to degradation.

And the first guideline is widely used specially in the developing nations like India and as a result one can find a close association of human beings, their settlement and cattle. The same ideology prevails in the study area when it comes to the utilization of available resources and can be verified in terms of the land use.

The density of human population is very high in the area largely because of the numerous salt and allied industries, the density further swells during monsoon season with the influx of migrants with their livestock. Also, there has been a sea change in the area in terms of urbanization and modernization. Large stretches of fringe area has been brought under cultivation with the help lift irrigation. Human activity and interference in the area since three decades has increased so much so that sizeable area has been brought under industries (salt, bromine and magnesium sulphate manufacturing industries) and irrigated agricultural cropland.

Problem of salinity

Problem of salinity is a major thing of concern in the entire study area. However, the problem of Salinisation is more severely felt in the fringe area for it is inhabited by the population. Salinisation is the accumulation of soluble salts of sodium, magnesium and calcium in soil to the extent that soil fertility is severely reduced. On the other hand salt is a very important natural resource of the area. Salt manufacturing is going on in the area for centuries. Some 22% of the total salt production of India comes from the Little Rann of Kutch. In the western part of the Rann, sea brine is used for the production of salt while in the rest of the Rann subsoil brine is used. As per the report of Gujarat Ecological Commission (1998), based on Remote Sensing data, the salt work area has increased from 69.48 sq km in 1982 to 133.57 sq km in 1995. There is scope for increase in salt work activity to cover 820.92 sq km. Increasing salt pans along the

fringe of the Rann is indicative of salinity spread in the area and simultaneously it also assist the salinity spread, degrading the fragile and delicate ecosystems of the area.

Physical verification and laboratory test suggests that there is higher salt content in the fringe area, not to mention about the Rann depression, where salinity is extremely high. The salinity was relatively much lesser along the streams and cropped area. In general the fallow lands were covered by the thin film of salts, especially more in the shallower area surrounding water bodies. Surface covered by the sheet of salts were deprived from any type of vegetation.

Osmotic potentiality of the salinity causes to retain water by the effected soil, leading to the drought stress to the plant, even though there is sufficient soil moisture. Salinisation processes are near to irreparable in the case of heavy-textured soils with high levels of swelling clay as that of the Rann Depression. However, in case of the fringe area particularly in the east and south-eastern part, the salinity can be reduced through preventive measures such as efficient drainage and flushing of the soil by water. Removal of salt from the soil is the only way to get rid of the problem of salinity, and this can be done through washing away of salt out of the root zone.

Salinity posses an environmental stress and is a discouraging factor for agriculture. The extent and degree of soil salinity keep on varying from time to time depending upon the climatic characteristics. Continuous rainfall may lead to the leaching of salts. The ponds in the fringe area help in draining the saline water from the soil, allowing agriculture in some patches. One can easily find the blazing white salt deposits along the bank of pond.

Examples of plants and crops with a high tolerance to salt such as bermuda grass, cotton, date palm, peas, rape and sugar beet can be well grown all along the fringe area for it falls within the similar agro-ecological sub region (Map-6.2).

Vertisol Management Problems

Soil management is a broad concept which encompasses soils, crops and the peoples who use them. Management of soil and water is the most difficult task, which comes in the way of vartisol management in the area of semi-aid tropics. The seeds or saplings of vegetation to be grown can suffer from extremes of drought or surplus of water, which result out of the water-logging over the clayey soil. Regulation of surplus water during the rainy season should be given priority in order to make the fullest utilization of the precious resource of the arid area which is water. Practically only a limited amount of water is being utilized.

Little Rann of Kutch being a rain scarce zone, the first priority has to make a full utilization of water received through rain. Usually farmers do not make full utilization of water in the study area because there is a range with reference to moisture, when tillage can be done and by the time much moisture is lost. When dry, soils are extremely hard and when wet, extremely sticky. Agricultural practices when the soil is too wet can lead to soil sticking while excessive dryness will make the soil too hard to cultivate. On the other hand waiting for this intermediate moisture content may cause delays in the cultivation and therefore water losses.

The soil remains uncultivated in the area during the first few weeks of rain because tillage cannot be done without sufficient moisture within. Thus the cultivated area remains fallow for good part of the rainy season. And that is why a very little amount of water is being utilized. If the initial rain in the rainy season is heavy and in large quantities than soil will get recharged with water upto a greater depth but in case it is lighter, the

cracks will be closed before much water has entered. The soil becomes practically impermeable after the cracks are closed, the infiltration rate falls abruptly only to form puddles. The patterns of infiltration and soil moisture are also uneven in the soil profile. Moisture enters upto a greater depth in the crack through direct entry but in between the cracks, lateral movement of water is slow.

Apart from the utility of rain water to its fullest, there is a need to provide satisfactory drainage system in order to facilitate the plant growth in the area. Since the rainfall varies in and around the Little Rann of Kutch, the techniques required for the soil and water management and agricultural practices do varies. In the area of relatively higher rain fall, the cultivation can be done properly on the convex slope, whereas, in the area of low rainfall, cultivation can be well done on the furrow. In case of former the excess water will be drained and could be stored in the depression area while in case of later the water could be brought to the cultivated area. The other alteration on the surface to facilitate the utility of land and water could be narrow and broad beds, mounds and ridges of low gradient. The role of ridges and furrows becomes opposite in different conditions.

Cropping systems are a major aspect of vertisol management, and different strategies have to be adopted according to the amount and distribution of the rain (Willey, 1987). For example, intercropping and relay cropping may increase yields several-fold, as found by ICRISAT in India (Kanwar and Virmani, 1987). This is only possible with a proper understanding of ecological phenomenon.

Desertification as identified in the eastern frontier of Rann is also a challenging problem, which generally crop up due to misutilization of land that is the land use which is not adapted to ecological condition to combat desertification and other ecological problems. The present land use practice needs to be controlled. Priority should be given to measures leading to the reorganization of the land use.

Vegetation distribution in the area at large is the manifestation of the soil development, moisture content and the salinity of the area. Further the fate of vegetation also depends upon the extent of men's utilization in terms of fuelwood, deforestation in order to cultivate and the extent of grazing. Sever grazing can cause retrogression in the grassland. The presence of Aristida, Eragrostis D. aegyptium, D.Sindicum, Corchorus, Fagonia and Chloris are the indicators of heavy grazing.

The growth of industries & salt pans has made a large encroachment on the area, which were earlier covered by mangroves. The bunds which, are made around the mangroves to trap the saline water from the sea had has an adverse effect on mangroves and gradually the salt chokes them to death. Unauthorized encroachment in the forested area for the purpose of agriculture & settlement has been rampant. Anthropogenic interference has had also an adverse effect on wetland.

Soil and water management are site specific because there are variation in the soil type and climatic conditions that is amount, distribution and reliability of rainfall. And therefore, considering the basic principles and patterns of morphology and ecology, relevant planning has to be done and management measures has to be taken.

Problem resulting out of environmental uncertainty in the semiarid is so sever that it has baffled the planners and has posed a tremendous challenge in the ecological planning. The traditional land use practice has evolved with response to the environment. However, with growing demand there has been considerable change in the land use pattern, the fallow lands have been converted into irrigated fields at the cost of natural vegetation, and this has resulted into the increasing salinity in the area.

6.6 PRIORITIES IDENTIFIED IN THE STUDY AREA

(i) 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 wind blown 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 an also huge area, which are 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:

(i) Classification of soil and creation of soil maps at adequate level.

(ii) Sustainable management and increase in the scrubland and mangroves, which will reduce the erosion.

(iii) Fire prevention and fighting.

(iv) Slope protection and flood control keeping in mind the environmental impact.

(v) Implementation of strict environmental laws.

(ii) Sustainable Management of Water Resources

Since the population exist only in the marginal area and therefore 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. One should need to understand the need and control of the demand. 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 microrelief patterns can also improve surface drainage include convex beds, ridges, narrow beds and furrows, and broad beds and furrows.

(iii) Land-cover restoration

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

(i) To recover the soils which are damaged by erosion, desertification salinisation, mining, deforestation etc.

(ii) Reclamation of saline waste areas and margins of Rann through checking the flow of saline water at small scale.

(iii) 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.

Table-6.1 Geomorphic Classification & Landscape ecological Planning measures

Sr. No.	GEOMORPHIC UNITS	ELEVATION	SURFACIAL EXPRESSION	LANDUSE	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	Dry Rann	7 feet (foot of Wasraj bet) to 25 feet (north of Jhilandhan)	Monotonous plain, covered with brine, clay and wind blown 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	Western Wet Rann	<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	Islands	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.