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SUGGESTED LAND USE AND AFFORESTATION OF WASTE-LAND IN THE NORTH-EASTERN PART OF THE ARAVALLI HILL GAPS

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ABSTRACT

The paper embodies the results of studies carried out on quaternary geology, geomorphology and desertification in the north-eastern part of Aravalli hill gaps around Sambhar salt lake in Rajasthan. The dominant landscape feature is the superimposition of earlier humid landscape by later aeolian deposits in semi-arid to arid climates.

The area is facing environmental problems due to sand accretion, soil. salinisation, soil erosion, flooding and water logging. These are the products mainly of erosional and depositional processes accentuated by overgrazing, deforestation, engineering constructions and unplanned cultivation on the dune tops.

INTRODUCTION

North-eastern part of the aravalli hill gaps is undergoing desertification mainly due to natural factors (e.g. semi-aridity, aeolian and fluvial cycles and neo-tectonism) further accentuated by biotic action. The gradual desertification has far reaching consequences on the man and regional ecosystem. The land use pattern to combat the desertification prevalent in the area is suggested in this paper.

MATERIAL AND METHODS

Geographical Setting

The studies were undertaken in 5000 km^2 area of the north-eastern part of the Aravalli hill gaps around the Sambhar Salt Lake, Danta-Ramgarh, Ghatuwa-Rupgarh, Bazor-Ranoli, Kantli, Mendha and Rupangarh river between N longitudes 74°, 48' and 75°, 42' and E latitudes 26°, 47' and 27°, 45'.

Ninety per cent of the rainfall (annual average 503 mm) is received between June and September, the maximum in July (av 172 mm) and the minimum (av 28 mm) in November. The dominant wind directions are westerly, north-westerly and south westerly. The maximum wind speed is 13.5 kmph during June and 3.5 kmph during November.

The area comprises discontinuous denudational and residual NNE-SSW trending hill range, hills and scattered inselbergs. The area is drained by the Sobawati, Kantli, Mendha and Rupangarh ephemeral rivers. The Kantli is an inland river while the Sobawati terminates in the Jin Mata depression. The Rupangarh and Mendha rivers debouch in the Sambhar Salt Lake. The remaining area is covered by undulating topography comprising older and younger sand dunes/sand sheet with local depression designated as playa. Besides these, there are the Nahargarh and Ramgarh ephemeral inland rivers and numerous small streams and wadis.

Hybro-geological Setting

The area is well drained by rivers and has ground water stream with sufficient recharge through meteoric water. The ephemeral Kantli, Sobawati, Mendha and Rupangarh and their tributaries togetherwith wadies form major source of surface water. The upper catchment of the ephemeral Sobawati river and Nahargarh nala are fed by springs located in the Khandela hills. The moisture contents around these area are very high. Distribution of subsurface water in quaternary alluvium is given in Table 1.

The ground water in hard rock is not much and is generally tapped in secondary opening of the hard rocks. It is deep and can be as deep as 70 m.

The land use and land form map of the area (1:2,50.000) were got prepared on the bases of studies of quaternary geological, geomorphological and environmental

Table 1. Distribution of surface water.

Source	Occurrence	Aquifer	Reservoir	Depth	Quality
Ground Water	i) Sand dune sand sheet	Palaeoch-annel F_1	good	35 m to 50 m	Sweet
		Palaeoch-annel F_2	Moderately good	15 m to 30 m	-do-
	ii) Abondoned playas and lakes	Palaeochannel F_1	Good	30 m to 40 m	Brackish
		Palaeochannel F_2	Moderatey good	10 m to 15 m	-do-
Perched	i) Sand dune/sand sheet	aeolian sand	Poor	2 m to 5 m	Sweet
	ii) Playa and lakes	Silty sand and Clay	Very poor	1.5 m to 2.5 m	Brackish
	iii) Rivers	Channel deposits.	-do-	1 m to 2 cm	Sweet

hazards with help of periodic aerial photo study (Fig. 1 and 2). Extensive pit and trench sections have been examined to supplement such studies.

RESULTS AND DISCUSSION

Geology, Geumorphology and Palaeocilmate

The unit is overlain by three distinct aeolian phases coeval with three lacustrine or pluvial phases interspersed by two wet phases fluvial sediments. The three phases of aeolian activities were deciphered on the basis of development of palaee soils and presence of artifacts. poterics and vertebrate bones on the top surfaees. The first phase sand dunes/sand sheets have been subjected to processes of erosion due to gullying and deep dissection. The dunes of first phase are present in the form of obstacle dunes around the hills and form flatter topography in peneplain area. The dunes of second phase are older stabilised and covered by later phases. These occur in longitudinal, transverse, parabolic and obstacle shape. The third phase comprises longitudinal, transverse, parabolic, barchanoid and obstacle types. These are under the processes of accretion, erosion and stabilization depending upon the dominant ppocess in the area. In the zone of accretion theae land forms are overlain by rmall obstacle, linear, barchans and star dune shapes.

Presently, the area has semi-arid climate in which both the fluvial and aeolian cycles are equally dominant. It is evidenced by the nature of rivers which have a tendency to erode head ward and form deep dissection and gully in the upper reaches, and vertical cutting in the older alolian and abnndoned playa and lake sediments. The river valleys thus are gradually widening, flattening and upgrading at their lower reaches.

The sources of sand are aggraded channels, playas, lakes. local depression and older sond dunes. Due to their barren nature the sediments of these land forms are recycled by prevailed wind pattern.

Suggested remedial measures to develop wasteland

Natural processes such as aeolian, fluvial cycle and climate, accentuated by biotic action etc. cause degradation of land. The land forms affected due to this process (Fig. 1) are given in Table 2.

The gradual degradation processes can be minimised and area protected from further degradation by adopting planned land use pattern, Biswas and Biswas 1980). The following remedial measures are suggested to reclaim wasteland.

To minimise the effect of erosion and deposition hazards due to aeolian and ifluvial cycles an afforestation across the dominant wind directions around the affected land forms is suggested.

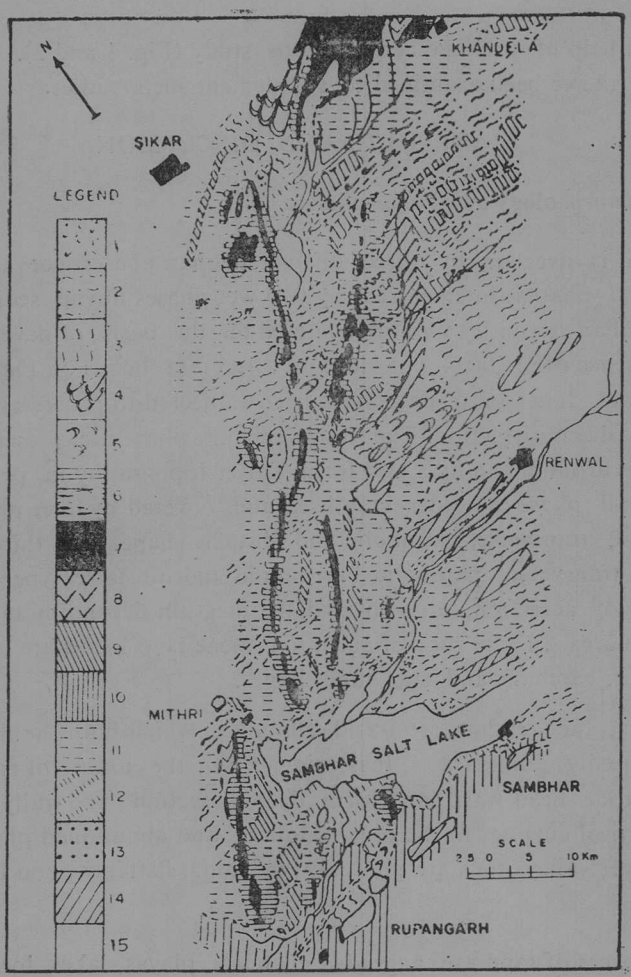

Fig. 1 Distribution of geomorphic land forms affected due to environmental degradation

Legend: 1 = Active sand dunes , associated with the zone of sand accretion,
2 = Longitudinal dunes , associated with the zone of reactivation,
3 = Transverse dunes , associated with the zone of reactivation and accretion,
4 = Barchanoid dunes , associated with the zone of accretion,
5 = Parabolic dunes , associated with the zone of reactivetion and accrction,
6 = Obstacle dunes , affected with gully erosion on the western sides of the hill and sand accretion on the eastern side,
7 = Structural and residual hills and pediments, affected due to sheet wash, rill wash and wind erosion,
8 = Broad flat valleys , affected due to sheet wash,
9 = Older buried palaeochannels , sweet water zones,
10 = Older flood plains , affected due to sheet wash,
11 = Sand sheet , affected due to gully erosion in the upper reaches of the Sobawati river,
12 = Younger flood plain , affected due to sheet wash,
13 = Developing playas , affected due to salinity hazards,
14 = Abandoned playas and lakes , saline and brackish water zones,
15 = Present rivers , playas, lakes and water ponds,

Table 2. Suggested land use based on environmental hazards, geomorphology and sediment characteristics

S. No.	Environmental hazard	Geomorphology	Sediment characte - ristics.	Suggested land use
1.	Sheet wash and wind erosion.	Residual hills pediment and pediplain.	Hard and Weathered rocks with oxidised grity soil.	Permanent total vegetation cover forest (wild life).
2.	Wind erosion and sand accretion.	Older and younger sand dunes.	Moderately oxidised to unoxidised.	Seasonal cultivation with afforestation.
3.	Gully erosion.	Oldest sand dunes and sand sheet.	Top part is oxidised, non calcareous.	Restricted cultivation, more pasture with afforestation.
4.	Aeolian and fluvial sand accretion.	Active sand dunes and aggreded ephe- meral rivers.	Unoxidised calcareous to non calcareous.	Pasture and fodder.
5.	Brackish water zone.	Abandoned playa and lakes covered by later saad sheet deposits.	Moderately oxidised.	Restricted cultivation with more pasture and afforestation.
6,	Saline water.	Shallow depression and playa.	Alkali soil	Pasture with afforestation.
7.	Free from any hazard.	Older, Younger flood plain and oldest and older sand sheet deposit.	Oxidised to unoxidised, calcareous to non- calcareous.	Regular cultivation with afforestation.

Trees like *Acacia juliflora. Opuntia elence*, *Beautia monosperma* etc. which can withstand the climate and have the tendency of rapid growth on all type of soils should be planted along the roads, canals, rivers, around the settlement, playa, lake, water ponds, loose wind blown sand accretion patches and zones and gully erosion affected area as per specification of forest department.

ii) To reduce the gradient of gully erosion affected area small check dams with effective water opening be constructed.

iii) All the depressions and playas be connected by developing a net work of canal system. These canals should be connected with an effective channel system to the Sambhar Salt Lake. This will lead to enrichment of salt in the Sambhar Salt Lake area.

Suggested land use

Keeping in view source of surface and under ground water, nature of sediment, characteristics of different geomorphic land forms and causes of degradation of land, a land use pattern is suggested

i) **Settlement**

Some of the areas of urban and rural settlements are being encroached by aeolian sand and at places ground floor has been covered by such accumulation (i.e. west of Bazor village). The settlements suffering from this malady, are confined to the zone of aeolian sand accretion and at the top of critical patches of active sand accumulation.

Of late people have started constructing buildings across the courses of drainage or towards the centre of abandoned playas. These constructions further obstruct the flow of water which flows in sheet due to gentle slope and absence of effective channel. The area is prone to flooding due to the presence of impervious kankar and clay bed at a depth of 1 to 2 m from the surface (Raghav, 1986). This also leads to water logging. It is suggested remedial measures and construction activities should be restricted to the bank of palaeo channel and abandoned playa.

ii) Construction of road, bridge and canal

Thc construction of cause way, road and railway bridge across the channel have caused an accumulation of sand along the course of the stream. This sand is recycled by wind to form dunes along the stream courses. These dunes in turn accelerate disorganization of the streams. The engineering constructions along these zones should be avoided and if necessary these should be aligned across the zones of environmental hazards by adopting suggested remedial measures.

iii) Cultivation

The cultivation on the dune tops has liberated sand which causes degradation of land mainly due to wind erosion. This recycled sand gets accumulated due to wind at the top of fertile land in adjacent area, thereby adversely affecting the fertility. The wind erosion can be combated by developing a afforestation belt. The area can be developed by adopting the following cultivation pattern.

a) Keeping in view the source of surface and under ground water the flood plain area, free from the environmental hazard or only slightly affected by environmental hazards can be put to regular cultivation.

b) The older oxidised sand dune and sand sheet areas have well developed soil profile and good resource of sweet ground water; these can be recommended for seasonal cultivation. These are also under the processes of erosion and deposition. Moreover with the onset of the summer the ground water table also goes down and at places becomes saline. The salinity affects the vegetation. This problem can be overcome by seasonal cultivation with effective afforestation (Fig. 2).

c) Some areas suitable for restricted cultivation are of two categories. Firstly zone of aeolian sand accretion are the areas of younger stabilised dune fields. (Fig. 2) For these, at the outset the biotic interference including cultivation should be stopped for a considerable period. Secondly the area should be afforested and dunes be stabilised by fencing, mulching or erecting microwind broaker and establishment of vegetation cover by seeding and plantation etc. The interdunal flat area consisting of silty sand and clay with high fertile soil can be recommended for the restricted cultivation. There should be some cultivation gap every 3rd and 4th year.

Second category is of brackish or saline water zone areas of abandoned playa and lakes which were buried under subsequent later oxidised aeolian and fluvial deposits. The fertility of the top soil of these areas has been depleted due to cultivation with the alkaline ground water. These areas can be commissioned for the restricted cultivation depending upon the surface water condition with effective afforestation.

iv) Fodder and pasture land :

The area severely affected by the environmental hazards due to aeolsan and fluvial proceses can be developed for the fodder and pasture lands after afforestation (Fig. 2). The various zones can be classified as below:

a) Zone of active aeolian sand accretion with loose aeolian sand, deviod of any vegetation cover. These areas should be brought under effective afforestation and develop by growing thorny bushes and grasses which have rapid growth after little

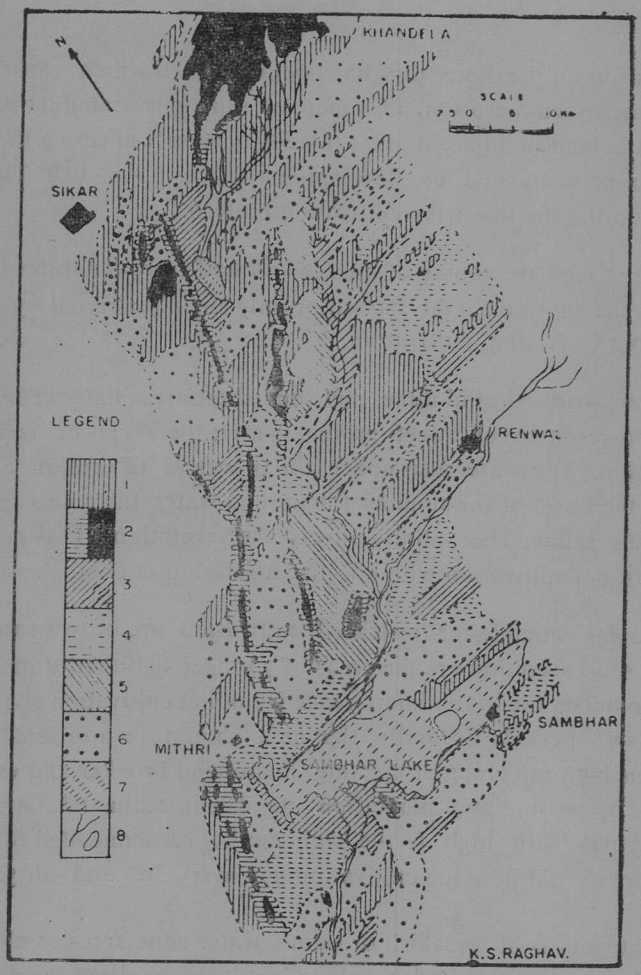

Fig. 2. Land use map of the sambhar salt like

Legend: 1 = Pasture and fodder land with restricted cultivation around stable interdunal flats.

2 = Permanent vegetation cover land for wild life development.

3 = Fodder and grazing land for alkaline soil development.

4 = Seasonal cultivation around older dunes with adopted-suggested remedial measures.

5 = Restricted cultivation around brackish water zones with suggested remedial measures.

6 = Regular cultivation around older alluvium and sand sheet.

7 = Salt producing area (Lakes).

8 = Horticulture and nursery land.

rainfall. Once the area is afforested and trees have grown, it can be used as fodder and pasture land with restricted opening.

b) Deeply dissected land with older oxidised stable sand dunes and sand sheet deposits, affected by the severe gullying. These can be brought under afforestation and can be developed as fodder and grazing lands (Sharma, 1980).

c) The area of playa and lakes ; the surface of these areas is devoid of any vegetation cover and is presently covered by alkali flats. These areas are aggraded due to centripetal drainage. Francois (1986) suggested that the surface area of such depressions can be developed by growing the species of bushes which can withstand the saline environment.

v) **Horticulture, plantation and nursery land**

The area of shallow ground water around the settlement playa, lakes, river bank and abandoned playa can be brought under horticulture plantation and nursery. It can be extended to pediment and pediplain area (Fig. 2).

vi) **Wild life forest**

The hill ranges confined to the western part of the area can be developed into permanent forests and can be used as wild life reserves. It will minimise the effect of environmental hazards and also check the movement of aeolian sand across the hills.

CONCLUSIONS

The environmental hazards prevalent in the area can be minimised and further degrabation of land can be arrested by adopting scientific land use pattern and afforestation, predominantly across the prominent wind directions.

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