isolates did not. Considering the varietal reaction results of sorghum against the three isolates, the differences between the isolates were quite significant. Bhowmick (1966) working with 3 isolates from Maize, I from (sorghum), 3 from Sudan grass and three from Johnson grass found that the plants developed leaf lesions regardless of isolates used on Ganga-1 maize seedlings.

The Bihar isolate is thus similar to the sorghum isolate of Bhowmick (1966) but the rest two isolates from Hyderabad are different. Apparently three physiologic forms seem to be present on this host in nature.

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ECOLOGY OF JALORE DISTRICT IN WESTERN RAJASTHAN[1]

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ABSTRACT

Ecology of Jalore district in western Rajasthan has been described. Environmental factors like the climate, soils and biotic features have been given. The vegetation has been mainly classified into spinous formations, edaphic formations and psammophytic scrub formations. These formations have been sub-classified as Desert thorn forest on low and medium altitudes (hills and sand dunes), mixed xeromorphic thorn forests on the plains, riverain thorn forest on riverbeds, halophytic scrub on shallow, saline depressions, psammophytic scrub formations on medium and low sand dunes and hummocks.

INTRODUCTION

Vegetation and plant communities can give us a correct picture of the ecological conditions since vegetation is a combination of various plant communities of different aspects and composition, each being the result of combined effect of all environmental factors and closely connected with the particular ecological conditions of the station in which they grow. The vegetation survey, as well as the study on the spot of the relative ecological conditions is a part of the integrated survey of natural resources in western Rajasthan on block level (Anonymous 1965, 1966, 1967), which

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has been undertaken by the authors in Ahor, jalore and Saila Panchayat Samitis in Jalore district. The result of these surveys are described in these pages.

Location and Topography

Jalore district is situated between lat. 24°, 45′ N to 26°, 0′ N and lat. 73°E to 71°E, surrounded by the state of Gujarat on the south, by Barmer district on the north and west and on the east by Sirohi and Pali districts, having a total area of about 6610 sq km. The terrain is mostly plain consisting of younger alluvium, sub-recent deposits of the older alluvium derived in part from in situ weathering of the bed rocks. Blown sand can be seen on the western slopes of Jalore hills forming dunes. The hills are mostly of the lower Vindhyan series consisting of Malani volcanics, Jalore granite and other basic rocks which are black to greenish, massive and compact.

Climate

The climate is characterised by extremes of temperature, erratic rainfall and high evaporation. The seasons are pronounced with six distinct *Ritus* (Misra, 1959). The annual rainfall varies from 300-350mm (in Saila), 360-450mm (in Ahor) to 358-480mm (in Jalore). The rainfall is subjected to fluctuations from year to year. About 90 percent of the total rainfall is received during the monsoon period. The temperature begins to rise from March, March—June are the hottest months of the year. The mean day temperature is 41°-42°C. During this season dust storms and dry dust raising winds frequently occur. With the onset of monsoon, towards the end of June, humidity considerably increases and the diurnal variation of temperature becomes only 8°-10°C as compared to 10°-14°C in other seasons. Withdrawal of monsoons takes place by the middle of September and the post-monsoon is characterised by slight increase in day temperatures. The winds are strong during May to September and are south-westerly.

Soils

In general the soils may be grouped as 1. Soils with yellow or yellowish colour peculiar to the deserts; the surface soil being sandy, porous and loose. 2. Grey brown soils similar to those of deserts but slightly heavier. These are medium to heavy textured soils and are characteristic of the aggraded alluvial plains and depressional areas with impeded drainage and salinity at lower depths. Depressional areas with high salinity are due to comparatively heavy textured clayey soils with impeded drainage. While salinity of some of the sandy loam soils is due to saline water irrigation and the capillary rise of underground saline water eg. at Alasan and Reothra of Saila block. 3. Coarse to medium textured soils, characterstic of the sandy plains, aggraded alluvial plains or flat lands or of old abandoned streambeds underlain by river gravels and 4. Soils on the hill tops and upper piedmont plains, which are shallow, lithosolic, stony and gravelly. Lower gentle slopes (1-4%) of foot hills may have coarse to medium textured colluvial soils ranging from sandy to sandy clay loam.

The average nutrient index (Parker, 1951, cited from Seth and Mehta, 1963) for the district is nitrogen 1·09, phosphorus 1·79 and potash 1·09, thus showing that the soils are low in nitrogen , medium in phosphorus and medium to high in potash. Most of the soils are normal with respect

mainly consist of *Anogeissus pendula* and *Acacia senegal* communities, the former develops on the protected hills, sensitive to biotic influence and possess poor regeneration capacity. Both *Acacia senegal* and *Anogeissus pendula* grow to a height of 6-7m with 20-30m BHG. Both the species are generally lopped, cut and browsed to a great extent. Such places are usually dominated by *Euphorbia caducifolia* community which has now been separately described by Champion and Seth (op. cit.) as Tropical Euphorbia scrub. Most of the rhyolite hills, which do not have any soil cover represent this type. Hillocks, easily accessible are the sites of its dominance. In the *Anogeissus-Acacia* type there are plants like *Wrightia tincto-* to pH and electrical conductivity, as more than 95 percent of the soils fall in this category.

Biotic Influences

The land utilization pattern of the district shows that 10·6 percent of the land is not available for cultivation, out of which 21·0 percent is put to non-agricultural use and 60 percent is barren and uncultivated. The area under forests is negligible (0.5%). Only 0.9 percent of the area is double cropped. Permanent pastures and grazinglands occupy only 3-4 percent of the total geographical area. Livestock constitute an important asset of the rural population. Considering the human and animal population, resources for forage and fuel are very limited. Hence there is a constant pressure on the vegetation in terms of fuel and fodder for grazing. The chief species which supply fuel are *Anogeissus pendula, Acacia senegal, Zizyphus nummularia, Z. mauritiana, Prosopis cineraria, P. juliflora, Acacia leucophloea, A. nilotica* ssp. *indica* and *A. jacquemontii*. In addition to these, almost all the shrubs and even the herbaceous species are scrapped from the ground for burning. Pressure on the grassland vegetation is so high that the grazing areas are in a very deteriorated condition.

Vegetation

Blatter and Hallberg (1921) recognised five main formations from the Indian desert. Champion (1936) recognised four main vegetation types while lately Champion and Seth (1964) recognised eight types. Shantisarup (1952) and Shantisarup and Vyas (1957) gave an account of the ecology of Jodhpur classifying the vegetation types on different habitats. Mathur (1960) recognised six forest types. Bharadwaj (1961) distinguished three primary and five secondary landform regions based on which Satyanarayan (1963) described the ecology of Central Luni basin grouping the plant communities under five groups. Chaudhury (1960) followed a geobotanical approach to the classification of vegetation. Plant communities have been studied by belt transect method of 15m width, the length depending upon the habitat. Groundflora was studied in smaller quadrats 1 × 1m size which has not been described in detail. The vegetation has been classified on different microrelief features as follows:

I. *Spinous formations of thorn forest on medium and low altitudes*. Hills—Nomenclature.—Northern thorn forest (Champion, 1936); *Anogeissus pendula* and tropical thorn forest (Mathur, 1960); Mixed xeromorphic thorn forest (Satyanarayan, 1963); and Desert thorn forest (Champion and Seth, 1964).

Occurrence.—These occur on the hilly outcrops. The hills are of two categories namely the high hill ranges and isolated

low hills including domes and tors consisting of granite and rhyolites on which the action of chemical weatherhing is very weak due to dearth of impregnated moisture. Yet chemical disruption along the joints fissures is a conspicuous feature. The outcrops are usually very steep covered with talus in case of rhyolite and boulders in case of granite. The slope varies from 40-60 percent. Except the upper slopes the flanks are thinly covered with talus creeps and skeletal soil is found in pockets. The top of these hills are almost angular. The soil cover is very meagre except in the cavities and depressions where accumulation is fairly good for plant establishment.

Structure and composition.—The forests *ria* R. Br., *Maytenus emarginatus* (Willd.) Ding Hou, *Cordia gharaf* (Forsk.) Ehrenb. & Asch., *Moringa cocanensis* Nimmo, *Salvadora oleoides* Decaisne, *Grewia tenax* (Forsk.) Fiori, *Melhania denhami* R.Br and *Commiphora wightii* (Arnott) Bhandari which are associated in the runnels where there is better soil and moisture status. *Zizyphus nummularia* (Burmf.) Wt. & Arn. is either absent or present as a prostrate bushy form.

The ground flora on the soil accumulated zone of the boulder sides and joints, especially on the windward side, include plants like *Tephrosia purpurea* (L.) Pers., *Barleria prionitis* L., *Pupalia lappacea* L., *Justicia procumbens* L., *Rungia parviflora*, *Boerhavia diffusa* L., *Leucas aspera* (Willd.) Spreng. and *Indigofera* sp. Most of these plants grow around the thorny scrubs which protect them from being browsed by the animals. Amongst grasses *Sehima nervosum* (Rottl.) Stapf. and *Cymbopogon jawarancusa* (Jones) schult, are the species on fairly deep soils with good moisture regime and are grazed off soon. Other grass species like *Oropetium thomaeum* (L.f.) Trin, *Tragus biflorus* (Roxb.) Schult, *Aristida funiculata* Trin. et Rupr., *Melanocenchris jacquemontii* Jaub. et Spach. and *Eragrostis ciliaris* (L.) R. Br. grow on shallow gravelly sandy soils and being less palatable may be seen later after the rains. The common climbers are *Cocculus pendula* (J.R.& G. Forster) Diel, *Asparagus racemosus* Willd. and *Ephedra foliata* Boiss. et Kotschy.

Piedmont Zone.—Nomenclature.—Same as in 1 above. Mixed xeromorphic forest including Tropical Euphorbia scrub (Champion and Seth, 1964).

Occurrence.—These are the places where there is a sharp break of slope. The upper part of this unit is degradational and the lower is aggradational formed by alluvial fans, the material of which has been washed down from the hills. The upper piedmont slopes (5-10%) are mostly covered with boulders and bigger rock fragments which are angular to subangular in form. The longitudinal gradient of the channels is here slightly deeper and as such water flows with speed during torrential rains. The lower slope is covered with gritty transported material and is formed by the sediments mixed with subrounded cobbles and pebbles brought by hill streams and sheet wash which formed the alluvial fans which later on coalesced together and achieved the shape of gently sloping land. The slope is generally 1-3 percent. The coarse surface deposit, mainly older alluvium, is shallow and poorly graded. The short streams radiating from the hill slopes are the natural drainage channels, they naturally die out in the outer periphery of the plain.

Structure and composition.—On the upper piedmont areas the vegetation is sparse, mostly dominated with scrubs of *Euphorbia caducifolia*, having a dominance of about 90 percent with 1-3m high

and 1-2m wide clumps. These clumps usually have at their centre saplings of *Acacia senegal, Anogeissus pendula* or *Salvadora oleoides,* which is mainly due to the better soil depth at the base of these clumps and the protection afforded to them. The lower piedmont areas, which gradually merge with the plains have a better vegetation cover due to good soil accumulation and ground water potential. The type of vegetation on these areas correspond to that on the plains and is of the mixed xeromorphic type with a mixture of spiny and evergreen species. The chief communities are *Salvadora oleoides-Prosopis cineraria* and *Euphorbia caducifolia* with relative dominance of 40, 25 and 20 percent respectively. The average height of *Salvadora* and *Prosopis* is 5-6 and 9-12m respectively with BHG 100-190 and 50-80cm. Other associated plants are *Acacia leucophloea* (Roxb.) Willd., *Maytenus emarginatus, Azadirachta* indica and *Cordia gharaf.* The common shrubs are *Capparis decidua* (Forsk.) Edgew., *Grewia tenax, Balanites aegyptiaca* (L.) Delile and *Zizyphus nummularia.* Among the grasses *Dichanthium annulatum* (Forsk.) Stapf. and *Sehima nervosum* are the most palatable and are soon grazed off, while other grasses like *Eleusine compressa* (Forsk.) Aschers et Schweinf., *Dactyloctenium sindicum* Boiss. are also found. Herbaceous flora is of *Boerhavia diffusa, Polycarpaea corymbosa* (L.) Lam., *Polygala erioptera* DC., *Indigofera cordifolia* Heyne ex Roth., *Justicia procumbens* and *Aerva persica* (Burm.f.) Merr.

II. *Mixed xeromorphic thorn forest on graded alluvial plain or desert plain.*—Nomenclature.—Mixed xeromorphic woodland or wooded desert (Satyanarayan, 1963); tropical thorn forest (Mathur, 1960); Salvadora and Zizyphus scrub (Champion and Seth, 1964); Northern desert thorn forest (Champion, 1936).

Occurrence.—These forests are on the flood plains formed by rivers and streams which are now dead and disorganised but were flowing during the Pleistocene and sub-recent times. The surface deposits in general are of coarse sediments with seggregated calcium carbonate and underlain by gritts and conglomerates which are the water bearing strata. Owing to almost level topography fine particles of sediments have been deposited which are comparatively heavier in texture. The regional slope of the land is 0.1 percent except in those parts where aeolian process is in operation. The natural drainage channels are almost absent, the availability of surface water is seasonal, depending upon the hydrostatic rise of the subterranean water in the dead channels during the monsoons. The original surface of the older alluvial plain in most of the places has been modified by aridity and accumulation of sand blowing of finer aggregates of colloidal nature. Hence, the surface is of loose consistency overlain by sandy hummocks. These may be nearly level lands varying to gently undulating and very gently sloping lands.

Structure and composition.—There are various plant communities recorded on this unit. Species like *Salvadora oleoides, Prosopis cineraria* (L.) Macbride, *Zizyphus nummularia, Capparis decidua* and *Acacia nilotica* (L.) Del. ssp *indica* (Benth.) Brenan and *A. leucophloea* are the chief component species. Main communities recorded from the surveyed area are 1. *Salvadora oleoides-Prosopis cineraria,* 2. *Prosopis cineraria-Capparis decidua-Zizyphus nummularia,* 3. *Salvadora oleoides-Prosopis cineraria-Capparis decidua,* 4. *Salvadora-Capparis decidua,* 5. *Prosopis cineraria* and 6. *Salvadora oleoides.* All these communities form open to very open forest

where inclusion or exclusion of any species play a significant role. A community of *Prosopis cineraria-Salvadora oleoides* has been described as the climax type of vegetation (Satyanarayan, 1963) on these areas.

Plant communities commonly seen on the 'Oran, Bir and Jhors' are *Salvadora-Prosopis, Prosopis-Capparis* and *Salvadora-Capparis* type. Some Orans are flat depressions filled with silt and clay where *Salavadora* type dominates while sandy flat areas support *Salvadora-Prosopis* type. *Salvadora* is generally found in the bushy form (*Salvadora* scrub, Champion and Seth, 1964). The shrubs and undershrubs are *Calotropis procera, Acacia jacquemontii, Cassia auriculata* L. etc. These are areas where *Cassia auriculata* has reached a "sub-climax" stage and hence it has been designated as *Cassia auriculata* scrub by Champion and Seth (1964).

Prosopis-Capparis is another community on areas with hummocky and undulating topography, which is common on the north and north-west of the district. The top sandy soils are loose and liable to wind erosion. *Prosopis cineraria* has a relative dominance to 60-75% and *Capparis decidua* 20-30 percent. In the cultivated fields , the density of *Prosopis* is 6-10 plants per hectare, while in Orans it is about 30-40 plants. Associated herbs and shrubs are sparse since these are exploited for fuel and fencing, the chief being *Zizyphus nummularia, Acacia jacquemontii* and *Calotropis procera*. The grasses are scanty and are grazed off as soon as they come up, the common species being *Cenchrus ciliaris* L., *C. prieurii* (Kunth) Maire, *C. biflorus* Roxb. and *Aristida* sp. etc.

There are other degraded communities like *Capparis-Leptadenia, Leptadenia-Aerva persica-Crotalaria burhia, Indigofera cordifolia* and *Cassia auriculata* scrub and desert dune scrub (Champion and Seth, 1964)

III. *Mixed xeromorphic thorn forest and riverain forests on flood plains.*—Nomenclature.—Northern *Acacia* scrub forest (Champion, 1936), Tropical thorn forest and sub-tropical thorn forest (Mathur, 1960), Mixed xeromorphic woodland or wooded desert (Satyanarayan, 1963) and riverain thorn forest (Champion and Seth, 1964).

Occurrence.—On either sides of the rivers Jawai and Sukri these forests are most common. This unit is of more recent origin than the older alluvial plain. The surface is agraded and comparatively free from much of blown sand. These have been built up by occasional floods in the rivers and consist of silt, sand and gravel transported from a long distance. The area is intensively cultivated both due to better soil conditions and assured water supply of sub-surface water. The surface is underlain by gritts and conglomerates at a shallow depth which indicate that this surface was actually bed of river Jawai, later on covered with deteritus brought down by flood water. The texture of the sediments, therefore, varies from loam to silty loam. Excepting for the chances of salinity at some confluences there is hardly any hazard. Only if the river is in spate there is chance of bank erosion but this is not of frequent occurrence.

Structure and composition.—Common plants in the cultivated fields are *Acacia nilotica* ssp. *indica*, ssp. *cupressiformis*, *Azadirachta indica*, and *A. leucophloea*. The chief plant communities recorded are *Acacia nilotica* ssp. *cupressiformis*-ssp. *indica, Prosopis cineraria* on cultivated fields where these species are protected and 2. *Salvadora-Prosopis cineraria-Acacia nilo-*

tica ssp. *indica* on the riverbeds. *A. nilotica* ssp. *indica* on favourable situations attain a height of 14-15m and BHG 50-90cm. *Salvadora oleoides* also forms thick bushy crown. Other associates are *Zizyphus nummularia, Prosopis juliflora, Balanites aegyptiaca, Cassia auriculata* and *Calotropis procera.* These species are generally removed from fields except *Zizyphus* which is retained by the farmers. The herbaceous flora consists of *Solanum surattense* Burm.f., *Xanthium strumarium* L., *Fagonia cretica* L., *Celosia argentea* L., *Achyranthes aspera* L. Commmon grasses are *Digitaria adscendens* (H.B.K.) Henr., *Dactyloctenium aegyptium* (L.) P. Beauv *D. sindicum* Boiss., *Dichanthium annulatum, Cynodon dactylon* (L.) Pers. *C. arcuatus* and *Cenchrus* sp.

IV. *Riverain thorn forest on the graded river bed.*—Nomenclature.—These are the edaphic formations which correspond to Dwarf semi-shrub desert (Satyanarayan, 1963); northern Acacia shrub forest (Champion, 1936) and riverain thorn forest (Champion and Seth, 1964).

Occurrence.—The beds of rivers Jawai and Sukri in the district are absolutely graded and are filled up by their deteritus consisting of assorted material. The channel is shallow and often with wide sandbars, sometimes mixed with silt and put under cultivation. During heavy flow of water, when the precipitation is slightly above normal, the banks are affected, being incapable of giving passage to the full discharge of runoff. Thus, bank erosion and flooding of the new floodplains take place.

Structure and composition.—Here the vegetation is mainly of plants like *Aerva persica, Alhagi pseud-alhagi* (M. Bieb) Desv., etc. The riverbed terrace supports community like *Salvadora persica-Tamarix dioica and Acacia nilotica* ssp. *indica.* Due to heavy biotic influence the vegetation assumes a bushy form. Shrub, undershrubs and herbaceous vegetation is the same as above except that species like *Mimosa hamata* Willd. and *Acacia Jacquemontii* are also found.

V. *Psammophytic desert scrub on the sand dunes.*—Nomenclature.—The vegetation on the sand dunes correspond to the inland scrub (Champion, 1936), desert dune scrub (Champion and Seth, 1964) and psammophytic scrub desert (Satyanarayan, 1963). The stabilised sand dunes support the xeromorphic thorn forest comprising of mainly *Acacia senegal* and *Prosopis cineraria* which are the open forest formations.

Occurrence.—The south west prevailing winds deposit fine grained, yellowish, calcareous sand in the form of longitudinal, transverse and parabolic dunes on the piedmont plains against the west, southwest flanks of the hills, which have been subsequently dissected by rains. They have assumed more or less "badland" topography. The dunes deposited on the plains have attained a maximum height of 30-50m (at Raithal and Korna). From the relief point of view the dunes may be classified as low, medium, high and very high; majority of them in the district belonging to the first two categories. High dunes may be closely spaced and more or less stabilised. Here the swales are periodically cultivated and due to this sand becomes loose and is liable for erosion by wind action. This erosion of top results in deposition of the blown sand to the neighbouring cultivated fields. There is, in fact evidence of much of the dunes having lost the top surface in the past exposing lime kankar layers. Widely spaced medium dunes are young and still in the process of formation. Others are actually the relics of previous high dunes which have been truncated by removal

of sand from their crests. These dunes which have calcium nodules strewn on the surface are old one's which need sufficient management to prevent sand from blowing them and depositing on productive land. Formation of new low dunes can be prevented by similar management at the source of supply of their sand which are the high dunes in the south-west of Saila block. Low dunes and hummocks are formed exactly in the same way and are periodically cultivated every 3-4 years. During cultivation they are levelled but they very soon revive.

Structure and composition.—Stabilised sand dunes bear tall trees of *Prosopis cineraria* and *Maytenus emarginatus*. Dunes with active crest do not support any tree vegetation on the crest. Semi-active or embryonic dunes do not bear any tree vegetation except a few psammophilous species like *Leptadenia pyrotechnica* (Forsk.) Decaisne, *Crotalaria burhia* Ham.ex Benth, *Aerva persica* and *Acacia jacquemontii*. Hillside dunes are mostly vegetated with hilly elements. The chief communities recorded are 1. *Prosopis cineraria*, 2. *Prosopis cineraria-Panicum turgidum*, 3. *Crotalaria burhia-Leptadenia-Aerva persica*, 4. *Capparis-Leptadenia*, 5. *Acacia jacquemontii-Aerva persica*, 6. *Acacia senegal-Salvadora oleoides-Euphorbia caducifolia*. Windward slopes of the dunes have higher vegetation cover as compared to the leeward side. The herbaceous flora invariably consists of *Aerva persica*, *Cenchru biflorus*, *Citrullus colocynthis* (L). Schrad. *Tephrosia purpurea* and *Cyperus arenarius* Retz. Dune crest is generally colonised by *Panicum turgidum* Forsk. and/or *Calligonum polygonoides* L. On the dissected stabilised dunes of Jalore hills *Acacia jacquemontii* is common and *A. senegal* reaches a height of 10-12m with 30-40cm BHG.

VI. *Halophytic desert scrub on shallow saline depressions*.—Nomenclature.—These are the edaphic formations corresponding to the halophytic desert (Satyanarayan, 1963); Rann saline forest (Champion and Seth, 1964 in part).

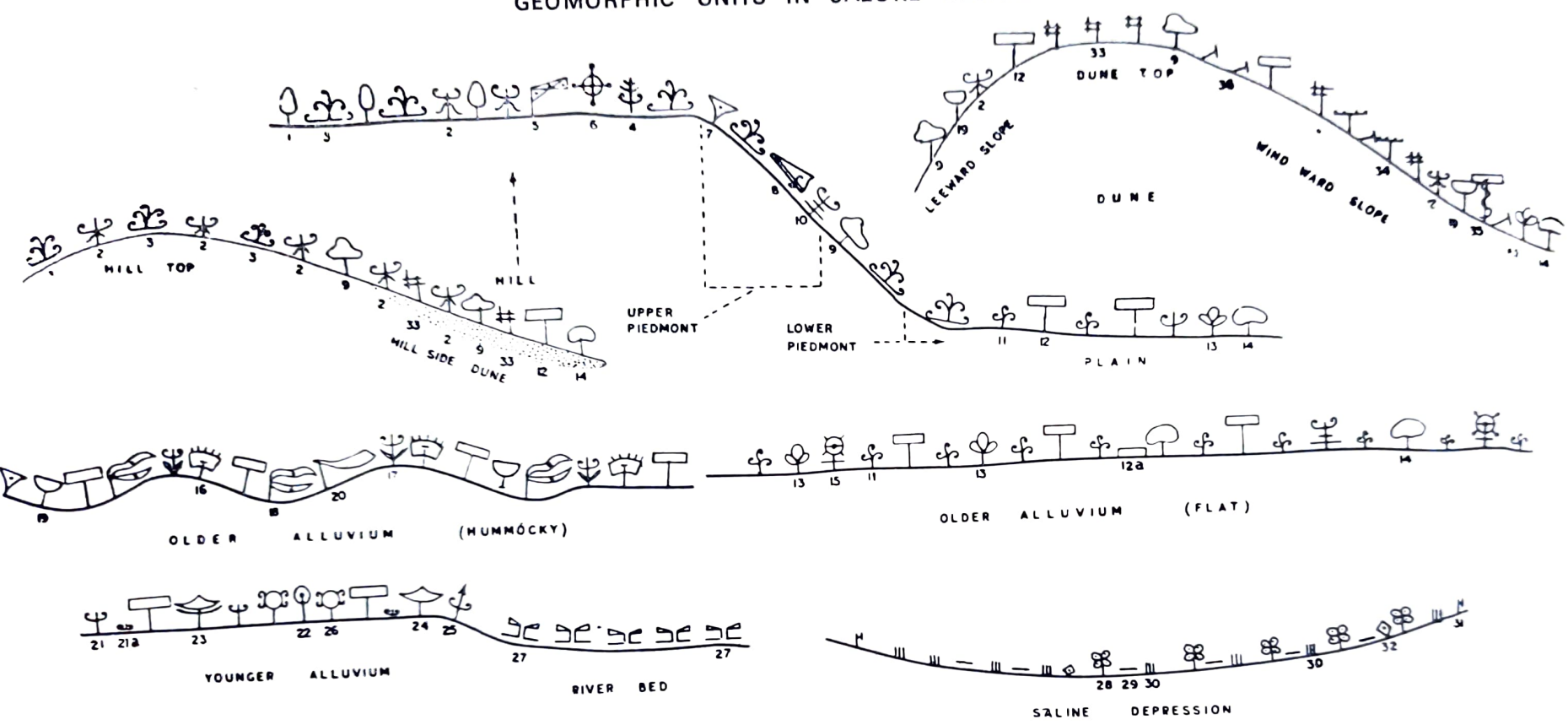
Occurrence.—This type of vegetation is on the saline depressions which are mostly of recent origin formed by gradual accumulation of salt in the disorganised channel fields with silt deposits. In Malagarh-Chaerda depression there are sand mounds of 3-5m relief with rounded tops consisting of calcareous fine sands which has been deposited by wind in the form of low dunes where typical psammophytic dune scrub is the dominant vegetation while in the flat areas halophytic scrubs form the dominant vegetation type.

Structure and composition.—The vegetation is dominated by nanophanerophytes or chamaephytes mostly of the family Chenopodiaceae. Areas with high salinity are blank without any definite plant community. The chief species recorded are *Suaeda fruticosa* (L.) Forsk., *Cressa cretica* L., *Haloxylon salicornicum* (Moq.) Bunge and *Portulaca oleracea* L. Among the grass species *Aeluropus lagopoides* (L.) Trin., *Sporobolus helvolus* (Trin.) Durr. et Schnitz and *S.marginatus* Hochst. ex *A.* Rich. are the most common. Depressional saline area near Alasan and Bakra (in Saila block) on the fringes supports plants like *Salvadora persica* L. and *Tamarix dioica*. Here the soil is sandy loam, non-calcareous at the top and calcareous below.

Rational Utilization and Management of Vegetal Resources

Rugged hills, piedmont areas, dissected sand dunes and free dunes should be closed from grazing, lopping and cutting of

SCHEMATIC PROFILES OF VEGETATION ON DIFFERENT GEOMORPHIC UNITS IN JALORE DISTRICT



1 Anogiesus Pendula
2 Acacia senegal
3 Euphorbia caducifolia
4 Moringa coccanensis
16 Lycium barbarum
17 Acacia jacquemontii
18 Leptadinea pyrotechnica
19 Calotropis procera
35 Cocculus pendulus
36 Aerva persica

5 Dichrostachys cinerea
6 Malhania denhami
7 Grewia tenax
8 Commiphora wightii
20 Clerodendrum phlomoidis
21 Acacia nilotica ssp. indica
22 Azadiracta indica
23 Ficus benghalenss
33 Panicum turgidum
24 Ficius religiosa

9 Maytenus emarginata
10 Acacia leucophloea
11 Cassia auriculata
12 Prosopis cineraria
25 Acacia nilotica ssp. cupressiformis
26 Balanitis aegyptiaca
27 Tamarix sp.
28 Suaeda fruticosa
34 Calligonum polygonoides

12a Prosopis cineraria (Prostrate)
13 Capparis decidua
14 Salvadora oleoides
15 Zizyphus nummularia
29 Aeluropus lagopoides
30 Sporobolus sp.
31 Cressa cretica
32 Portulaca oleracea
21a Acacia nilotica ssp. indica (Prostrate)

trees. Natural regeneration of plants should be encouraged by enclosures in compartments. The cultivation of sand dune should be discouraged. Intercropping of legumes and grass mixture along with natural vegetation may be allowed to come up. On hills, species like *Acacia senegal, Anogeissus pendula* and *Grewia tenax* may be tried for afforestation, which will not only check soil erosion but will provide fuel and to some extent top-feed for animals. Sand dunes may be afforested with *Calligonum polygonoides, Zizyphus mauritiana* and a few exotics like *Acacia tortilis* and *Prosopis juliflora* in order to meet the immediate fuel requirements. Dissected dunes and piedmont areas may be planted with *Salvadora oleoides, Acacia leucophloea, Capparis decidua* and *Zizyphus nummularia.* Much of the area, presently utilised as wasteland, abandoned fields, common grazinglands etc, may be improved by putting them under pastures. Such areas should be closed in compartments and natural vegetation should be allowed to come up. Reseeding with nutritive, palatable grasses and legumes like *Lasiurus sindicus, Cenchrus ciliaris, C. setigerus, Dichanthium annulatum, Dolichos lablab, Crotalaria medicaginea, Rhychosia minima, Phaseolus, atropurpureus, Atylosia scarabaeoides* may be practised. *Lasiurus* is suitable for light sandy soils while *Cenchrus* does not make heavy demand on the soil. Soils with better moisture holding capacity may be covered with *Dichanthium annulatum.* Abandoned stream channels with impeded drainage may be utilised by enclosing the areas together with soil conservation practices and seeding with suitable grass-legume mixture for pasture development. Farm forestry should be encouraged in cultivated fields.

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