

Sand Dune Vegetation of Cholistan (Pakistan) and Some Control Measures Against Wind Erosion

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Introduction

Cholistan is a vast sandy desert covering an area of 2407 km² and is locally known as Rohi. The area is dominated by sand dunes as high as 12m. There are however, patches of leveled areas lying between the dunes. The Hakra River divide the area into smaller and greater Cholistans. The smaller Cholistan lies in the north of Hakra depression and is relatively flat with a few low sand dunes. The greater Cholistan lies in the south and is entirely occupied by large sand dunes. The encroachment of dunes from the greater Cholistan is a continuous danger for the local people. It is important to have a full knowledge of the natural vegetation composition of this area. The present study enlightens this aspect along with suggestions for the stabilization of sand dunes.

Methods of Study

Sand dune sites in the Cholistan area were surveyed for vegetation changes and samples taken from these sites were analyzed. The pH values were determined by a Beckmann pH meter; whereas the texture was determined by Bouyoucus Hydrometer.

Observations

a) Climatic factor: Cholistan enjoys an arid climate. In summer, temperature is as high as 51.6°C, and in winter it goes down below freezing point. May and June are the hottest months of a year. Average annual rainfall is 128mm to 178mm. Most rainfall is during summer but winter rains are also common. Due to little rainfall and long spells of drought, sometimes ranging between 2-4 years, water is scarce in Cholistan. The only water source is that available at 25-90 m depth but this is too brackish. As such, naturally growing grasses, bushes, shrubs and trees are frequently damaged by drought.

b) Edaphic factor: There are mainly two types of soils in Cholistan, namely, sandy soils and clayey soils. The sandy soils are found on stable and unstable dunes. These soils are coarse in texture and show a 8.1 pH. Though the soils lack in carbonates but they are rich in other exchangeable bases. The clayey soils are of three types and are locally known as hakran wala dahar, chitta dahar and ratta dahar. Soils of hakran wala dahar are rocky in nature and without any vegetation, whereas chitta dahars are as patches between the dunes. Their texture is heavier and pH is 8.2. These two are devoid of any vegetation. The ratta dahars show a coarse texture with a considerable proportion of clay in deeper layers. With pH values ranging from 8.3 to 8.5, the soil supports a good vegetation the surface layers are free of excessive salts containing fair quantity of soluble calcium which balances the effects of excessive sodium.

c) **Biotic factor:** Man plays a very important role in the area. The ranges in Cholistan are subjected to heavy grazing. The seedlings are destroyed before they get established resulting in a considerable loss of the seeds. Thus there is a decrease in the forage production. Roots of Lasiurus hirsutus are dug out and brushes made for use in the cleaning of earthen wares whereas Calligonum polygonoides roots are used for making milk churns. Similarly twigs of Leptadenia spartium are used for making brushes and ropes. The destruction by man accompanied by grazing of deer, burrowing of hares and rats add to the already deteriorating situation.

d) **Vegetation:** The vegetation of Cholistan is mainly xerophytic in nature. The distribution and diversity of vegetation is mainly controlled by the edaphic and climatic factors discussed above. In all 53 species were observed to grow (Table I).

Table: I
List of species observed in Cholistan.

<u>Acacia arabica</u> (Lamb.) Willd.	
<u>Aerua tomentosa</u> Forssk. (Boil *)	
<u>Albizia lebbeck</u> (L.) Bth.	
<u>Alhagi camelorum</u> Fisch (Javan*)	
<u>Aristida depressa</u> Retz. (Lamb*)	
<u>A. mutabilis</u> Trin. and Rupr.	
<u>Azadirachta indica</u> (L.) A. Juss. (Neem*)	
<u>Calligonum polygonoides</u> L. (Phog*)	
<u>Calotropis gigantea</u> R.Br.	
<u>C. procera</u> (Willd.) R.Br.	
<u>Capparis aphylla</u> Roth.	
<u>C. decidua</u> (Forssk) Edgew. (Karir *)	
<u>Cenchrus ciliaris</u> L. Dhaman*)	
<u>C. pennisetiformis</u> Hochst. and Steud	
<u>C. schoenanthus</u> L. (Khawi *)	
<u>Chrozophora tinctoria</u> (L.) Juss.	
<u>Cistanche tubulosa</u> (Schenk) R. Wight	
<u>Citrullus colocynthis</u> (L.) Schrad.	
<u>Cleome brachycarpa</u> Vahl ex. DC.	
<u>Corchorus depressus</u> (L.) Stocks.	
<u>Crotalaria burhia</u> Ham. ex. Bentham	
(Chag*)	
<u>Cymbopogon jwarancusa</u> (Jones)	
Schult. (Khawi*)	
<u>Cyperus rotundus</u> L.	
<u>Dactyloctenium aegyptium</u> (L.) P. Beauv	
<u>Datura alba</u> Nees	
<u>Desmostachya bipinnata</u> (L.) S. apf.	
<u>Dichanthium annulatum</u> (Forssk) Stapf	
	<u>Digitaria pennata</u> (Hochst) T. Cooke.
	<u>Dipterygium glaucum</u> Dene. (Thuma*).
	<u>Eleusine compressa</u> (Forssk) Aschers and
	Schweinf. ex. C. Christ (Chimbar*)
	<u>Eragrostis Japonica</u> (Thunb) Trin.
	<u>Euphorbia prostrata</u> Alt.
	<u>Fragaria cretica</u> L.
	<u>Haloxylon recurvum</u> Bunge ex. Baiss. (Khar*)
	<u>H. salicornicum</u> (Moq.) Bunge ex. Boiss
	(Lana*)
	<u>Kochia indica</u> Wight.
	<u>Lasiurus hirsutus</u> (Forsek) Boiss. (Gorkha*)
	<u>Leptadenia spartium</u> Wight. (Khip*).
	<u>Orobancha</u> sp. L.
	<u>Panicum antidotale</u> Retz. (Mort*)
	<u>P. turgidum</u> Forssk.
	<u>Peganum harmala</u> L.
	<u>Polypogon monspeliensis</u> (L.) Desf.
	<u>Prosopis spicigera</u> L. (Jand*).
	<u>Salsola foetida</u> Del. (Lani*).
	<u>Salvadora oleoides</u> Dene. (Pilu*)
	<u>Solanum nigrum</u> L. (Mako*)
	<u>S. xanthocarpum</u> Schrad. and Wendl.
	<u>Suaeda fruticosa</u> (L.) Forssk (Lana*).
	<u>Tamarix aphylla</u> (L.) Karst (Farash*)
	<u>Tribulus terrestris</u> L. (Bhakra*)
	<u>Withania somnifera</u> (L.) Dunal
	<u>Zizyphus nummularia</u> (Burm. f.) W. and A.
	(Mallah*)

*) local names.

e) **Vegetational Zonation:** A typical zonation can be observed easily on the sand dunes. On the top of the dunes (stabilized) Haloxylon salicornicum and Calligonum polygonoides are the dominant species. These species are good soil binders and do not require much moisture, as their roots can penetrate deeper in search of water. Grasses like Cymbopogon jwarancusa, Panicum antidotale, Digitaria pennata, Dichanthium annulatum and Eragrostis japonica are found to cover the middle of dunes. These too are good soil binders and have a high fodder value. At the bottom of dunes the dominant species are Haloxylon recurvum, Aerua tomentosa, Leptadenia spartium, Zizyphus nummularia, and Crotalaria burhia. However, species like Alhagi camelorum, Tribulus terrestris, Euphorbia prostrata, Calotropis procera and C. gigantea were observed to grow abundantly in shady habitats of the dunes. These plants are neither soil binders nor have they any fodder value. The eradication of these species will provide a chance for the regeneration of the species would be useful for the stabilization of the dunes.

f) **Succession:** Seeds of Eleusine compressa and Salsola foetida brought by wind are first to get established on the dahars. With the deposition of more and more sand species like Suaeda fruticosa, Haloxylon recurvum, Cymbopogon jwarancusa, Capparis decidua, Prosopis spicigera get established. After September, sand dunes stop moving. If the climatic conditions become favorable and biotic interference is reduced the vegetation starts coming up. Dipterygium glaucum comes first as colonizer on sand dunes followed by Aristida depressa. Bushes like Calligonum polygonoides, Haloxylon recurvum, H.salicornicum and Lasiurus hirsutus appear later. Thus the dunes get established. The bushes like Capparis decidua and Prosopis spicigera grow in sheltered places whereas Cenchrus ciliaris is found to grow only on the moist soil where conditions are comparatively better for its growth. We can, therefore, imagine that during the past when the moisture conditions were better and without heavy grazing these species were growing as climax species. Heavy grazing has resulted in the retrogression of vegetation. A sub-climax species Lasiurus hirsutus thus, occupies the area.

g) **Suggestions:** Cholistan is a desert where evaporation far exceeds the precipitation, even vegetation consumption the latter. Thus following suggestions are deemed to yield good results:

1.Stabilisation of the sand dunes: Vegetation and moisture are the two factors which can bind sand dunes. These two factors are interrelated and the best method to bind these would be to utilize the moisture present in dunes for raising vegetation; otherwise this moisture will disappear in no time leaving the sand dunes at the mercy of severe gales. In all the advanced countries of the world, where such a menace exists various sand binding species have been tried. Usually the grasses have served this purpose. The tough binding grasses with their harsh tufts check the wind, trap on-coming supplies of sand and continue to grow outwards as the entangled sand accumulates leaving behind them an intricate network of long roots. Such protective dunes become leveled up and tufted over. Some tree species have also been tried for this purpose elsewhere. However stress should be laid upon local species than introducing exotic ones. Since dunes have three locations and possess different water content, following species are strongly recommended for plantation at different zones of dunes. The top of a dune should be planted with Calligonum polygonoides, H.salicornicum, Salsola foetida, Dipterygium glaucum, Capparis aphylla, Kochia indica, Salvadora oleoides, Suaeda fruticosa, Acacia arabica, Prosopis spicigera and Azadirachta indica. The middle of the dunes with Lasiurus hirsutus, Eleusine compressa, panicum antidotale, Cymbopogon jwarancusa, Cenchrus pennisetiformis, Dipitaria pennata, Dichanthium annulatum, Aristida depressa, Demostachya bipinnata, Eragrostis japonica and bottom of the dunes with Haloxylon recurvu, Aerua ~~tomentosa~~, Leptadenia spartium, Zizyphus nummularia, Crotalaria burhia, Citrullus colocynthis, Solanum xanthocarpum, Peganum harmala, Fagonia cretica, Tribulus terrestris, Aihagi camelorum, Corchorus depressus and Cleome brachycarpa. It will be feasible if the seeds, tufts, cuttings or entire plants, as the case may be, of the above species are planted immediately after the rains in July and August. The species like Datura alba, Withania somnifera, Calotropis procera, C.gigantea, Euphorbia prostrata, Cistanche tubulosa, Solanum nigrum, Chrozophora tinctoria and Orobanche sp. are unpalatable and possess no economic importance. These species are certainly a drain on the Cholistan habitat. The introduction of economically important and palatable species, after the eradication of the latter species, will not only increase the potential wealth of the area but also help boost up the economy of the inhabitants of this area.

2. Management: Proper management of natural resource is necessary for its best utilisation. Cholistan has a very limited and subnormal vegetation cover. It is, thus, imperative that necessary steps should be taken not only to restore it to its original level but also to improve it. As such, grazing should be limited by marking areas left for grazing and others should be kept under strict surveillance or a barbed wire used for demarcation of the areas. Census of the wild lives is also important since it is dependent on the vegetation of the area. Before any number of livestock is allowed to graze in a particular area the possible number of wild life should also to be taken into consideration. Monitoring of the economic plants of the area is needed. These plants should be allowed to be cut in such a manner that they do not jeopardize the existing bad situation. The parasitic species like Orobanche sp. and Cistanche tubulosa should be eradicated.

3. Development of water points (Tobas): This step is of paramount importance. The best time of dig the points is before rains on dahar soils. This would help accumulation of maximum amount which can be used for irrigation and other purposes later on.

4. Plants of economic importance: Plantation of plants like Zizyphus sp., Albizzia Iebbek, Tamarix aphylla and Haloxylon recurvum, because of their economic importance, should be encouraged, Haloxylon recurvum is a source of great income for the area. It is a source of nitrate used on large scale in the soda ash factory for the manufacture of soap. This species germinates profusely immediately after rains. The seeds of the plant may be broadcast by planes or helicopters to increase its density and coverage. The species apart from all its qualities is a very good soil binder.

5. Wind barrier species: Planting for wind breaks of species like Phragmites karka, Arundo donax and Saccharum spontaneum are useful to check the blowing sands from coming into crops.

6. Control of poisonous plants: Some of the following poisonous plants needs attention because they are unpalatable and poisonous: Ricinus communis, Datura alba, Withania somnifera, Calotropis procera, C.gigantea, Euphorbia prostrata, Cistanche tubulosa, Solanum nigrum, Chrozophora tinctoria, Orobanche sp.