PHYTO-ECOLOGICAL STUDIES OF THE FLOOD PLAINS OF DERA ISMAIL KHAN, PAKISTAN

by

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Abstract. *Phyto-ecological studies of the flood plains of Indus river near Dera Ismail Khan, Pakistan, were carried out and five plant communities were established.*

Introduction. Dera Ismail Khan district is situated in the southern part of the North West Frontier Province of Pakistan and lies between 31°15′ and 32° 00′ North latitude and 70°05′ and 71°32′ East longitude. The district is bounded on the North by the crest of Bittani and Marwat ranges, on the West by Shirani and Marwat ranges, on the North West by Shirani and Sulaiman hills, on the South by Dera Ghazi Khan district, and on the East by the Indus river. It has an area of approximately 6,000 kilometres. The district is named after its capital city, which is located on the bank of Indus river. The area selected for the phyto-ecological studies comprises the flood plain of the Indus river near North-East corner of the town of Dera Ismail Khan.

The climate of the area is arid, sub-tropical, and continental with a mean annual precipitation of 242 mm (recorded for 1970-74). The bulk of precipitation (173 mm) is received during spring and summer months. Spring receives 68 mm, summer 105 mm., autumn 31 mm., and winter gets 38 mm (table I).

Summers are very hot and winters cool. In winter, the temperature sometimes gets near the freezing point with a lowest mean minimum of 3.75°C falling in the month of January. The absolute minimum temperature recorded during the period is 0.4°C. The frost may, therefore, occur rarely. The mean maximum temperature is 39.16°C which occurs in the months of May and June, the hottest months in the year. The absolute maximum temperature recorded was 51.77°C in the month of June during the period.

Not much has been written on the soils of Drea Ismail Khan. A reconnissance soil survey made by the Soil Survey of Pakistan (1969), however, throws some light on this aspect.

Levees, meander scars, and swamps are among the prominent land features of the flood plain. These features are subject to continual change due to deep flooding, and erosion, which occurs once or more during the months of June-Sept. Almost every year

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during floods, fresh sediments are received and a "Kutcha" area is built up in the flood plain, marked by the meander scars and old river channels. This alluvium is derived from a wide range of igneous, metamorphic, and the sedimentary rocks of the Himalayas.

The soils are both recent and sub-recent in age and have great local variations in the profile, which is the result of different depositional patterns. The soils range from sandy to clayey. Most profiles contain course and moderately course materials, while others have medium and fine textured mantles of varying thickness over-lain on sandy substratum.

TABLE I

Climatic data for Dera Ismail Khan (The figures include the averages of* 1970-1975)

Months	Rainfall (mm.)	Temperature (°C)			
		Mean Max	Mean Min.	Heighest Max.	Lowest Min.
January	10.00	19.45	3.75	20.36	0.38
February	22.25	22.91	6.83	27.75	8.55
March	30.25	26.75	14.16	35.02	8.55
April	8.00	34.94	19.38	41.39	14.83
May	31.25	39.16	24.05	44.72	17.50
June	13.75	39.16	28.39	50.66	11.50
July	135.85	37.72	26.88	40.11	20.38
August	29.75	37.19	26.77	41.11	20.55
September	20.50	36.47	23.55	39.16	19.83
October	0.50	24.33	14.33	37.08	11.66
November	9.25	26.94	13.50	33.61	9.72
December	5.00	22.26	7.35	28.05	1.11

*Courtesy of Pakistan Meteorological Department, Lahore.

The soils are young and have no signs of profile development. The water table, in general, is at 2-3 metres, but it is quite high further west where water is drawn by tube-wells and persian wheels.

Some areas lie above seasonal floods and do not receive fresh sediments. They are found only in patches. Soils in these spots are medium to coarse textured, with a sandy horizon occurring at shallow depths, and are used for cultivation. The main crops raised are pulses, wheat and gram.

No study seems to have been made on the vegetation of the flood plains of D.I. Khan. The report on the phytosociological and ecological studies on similar habitats in the riverain forests of Hyderabad Region by Zeller and Beg (1969) is the only reference available. Observations in the area and discussions with the local population revealed that the vegetation changes from one place to another depending upon the soil profile, degree of summer flooding and erosion. Unchecked burning and overgrazing, too, may contribute towards the modification of vegetation.

A phyto-ecological survey of these plains was made to find out the land potential and the vegetational set-up of the area.

Methods. The entire area was divided into six stands depending upon the periodicity of its flooding. The size of the stands ranged from 5-10 acres. Soil samples were collected from each stand and studied in the laboratory for textural composition. In each stand 24 quadrats of 10 x 10 metres were laid randomly. The number of trees of various species was counted in each quadrat as well as circumference of each tree at breast height recorded. Frequency, density, and dominance were calculated for each tree species, and "Importance Values" determined using the following formulae (Cox, 1967):

$$\text{Density} = \frac{\text{number of individuals}}{\text{area sampled}}$$

$$\text{Relative density} = \frac{\text{density for a species}}{\text{total density for all species}} \times 100$$

$$\text{Dominance} = \frac{\text{total of basal area}}{\text{area sampled}}$$

$$\text{Relative dominance} = \frac{\text{dominance for a species}}{\text{total dominance for all species}} \times 100$$

$$\text{Frequency} = \frac{\text{number of plots in which species occurs}}{\text{total number of plots sampled}}$$

$$\text{Relative frequency} = \frac{\text{frequency value for a species}}{\text{total frequency values for all species}} \times 100$$

$$\text{Importance value} = \text{relative density} + \text{relative dominance} + \text{relative frequency.}$$

TABLE 2

Location, soil type, and flooding situation of the various stands investigated.

Stand No.	Location	Soil type	Flooding situation
I.	Mandra. 7 miles N.E. of D.I. Khan.	Sandy loam	Not flooded for 5-10 years; dry.
II.	Rakh Mandra. 6 miles N.E. of D.I. Khan.	Sandy loam	Annually flooded; periodically moist.
III.	Bacchari and Jhok Thoti. 7 miles N.E. of D.I. Khan	Clay loam	Annually flooded; moist.
IV.	Himmat. 3 miles N. of D.I. Khan.	Sandy loam-clay loam	Annually flooded; swampy.
V.	Thoa. 2 miles N. of D.I. Khan.	Sandy loam-clay loam	Annually flooded; moist.
VI.*	D.I. Khan proper.	Sandy loam	Not flooded for at least 3-4 years; dry.

*Stand No. VI is essentially like stand No. 1.

TABLE 3

Phyto-ecological attributes of herbs and shrubs in various stands.

Stand No.	Species	Coverage/quadrat (percentage)	Frequency (percentage)	Summation value
I.	*Calotropis procera*	14.10	25.0	39.10*
	Tamarix dioica	11.37	25.0	36.37*
II.	*Saccharum spontaneum*	13.37	20.0	33.37*
	Tamarix dioica	5.37	20.0	25.37*
	Alhagi maraurum	1.62	15.0	16.62
	Typha angustata	2.62	10.0	12.62
	Lippia nodiflora	1.00	10.0	11.00
	Cyperus rotundus	0.12	5.0	5.12
III.	*Lippia nodiflora*	6.87	25.0	31.87*
	Tamarix dioica	2.25	15.0	17.25*
	Cyperus rotundus	0.25	10.0	10.25
	Melilotus officinalis	0.37	10.0	10.37
	Alhagi maraurum	0.37	10.0	10.37
	Saccharum spontaneum	2.62	10.0	12.62
	Typha angustata	1.87	5.0	5.87
IV.	*Ranunculus scleratus*	3.60	20.0	23.00*
	Cyperus rotundus	0.37	15.00	15.37*
	Melilotus officinalis	0.25	10.00	10.25
	Alhagi maraurum	0.75	5.00	5.75
	Lippia nodiflora	0.87	10.00	10.87
	Typha angustata	2.60	10.00	12.72
	Saccharum spontaneum	1.50	10.00	11.50
	Tamarix dioica	0.75	5.00	5.75
V.	*Alhagi maraurum*	3.37	20.00	22.37*
	Cyperus rotundus	0.32	15.00	15.32*
	Lippia nodiflora	0.87	10.00	10.87
	Tamarix dioica	0.87	10.00	10.87
	Typha angustata	0.75	5.00	5.75
	Ranunculus scleratus	0.25	10.00	0.25
	Saccharum sponteneum	0.75	5.00	5.75
VI.	*Calotropis procera*	24.4	30.00	54.4*
	Tamarix dioica	18.5	20.00	38.5*
	Lippia nodiflora	5.0	10.00	15.0
	Alhagi maraurum	1.8	5.00	6.8

*Species constituting the communities in various stands.

For sampling herbs and shrubs, small quadrats of 2 x 2 metres were laid in the opposite corners of each main quadrat. In this way, the total number of small quadrats came out to be 48 per stand. Frequency and percentage canopy cover were calculated for each species, and "Summation values" determined according to the following procedure (Daubenmire, 1959).

$$\text{Frequency} = \frac{\text{No. of plots in which a species occurs}}{\text{total number of plots sampled}} \times 100$$

$$\text{Percentage canopy cover} = \frac{\text{Total canopy cover in all the quadrats}}{\text{total number of quadrats in a stand}}$$

For calculating the canopy cover for each species in a quadrat, the middle point of the cover class of each species in the plots was taken into consideration as an average value. This value is already in precentage.

Summation value of each species (in a stand) = Frequency of each species + Percentage canopy cover.

Results. Table 2 shows the location of each stand, general soil type, and the flooding periodicity. The table indicates the predominance of sandy soils in those stands which are not flooded annually.

The data collected on the various phyto-sociological attributes of the various species in six stands was further analysed in order to establish communities. For tree species, the "Importance Values" were used as criteria for determining the importance of the species for controlling the community. However, during the course of investigation, only one tree of *Dalbergia sissoo* and seven trees of *Acacia arabica* were recorded from stand No. I. Because of their insignificant number, these trees were excluded from further vegetational analysis of the stand. No tree was recorded from any other stand.

In the case of herbs and shrubs, the communities were established on the basis of the "Summation values" of the plants in each stand. The plant communities were named after the pair of species having the highest values in each stand. Table 3 shows the summary of these results, on the basis of which the following plants communities were established for each stand:

Stand No. I and VI

Calotropis procera — *Tamarix dioica* community.

Stand No. II

Saccharum spontaneum — *Tamarix dioica* communtiy.

Stand No. III

Lippia nodiflora — *Tamarix dioica* community.

Stand No. IV

Ranunculus scleratus — *Cyperus rotundus* community.

Stand No. V

Alhagi maraurum — *Cyperus rotundus* community.

Discussion and Conclusions. The studies revealed that the flood plains of the Indus river, near Dera Ismail Khan, are mainly vegetated by annual and perennial species of herbs and shrubs. On the whole, the vegetation is not stable and is subject to change due to seasonal flooding. Stand No. I was the only site where trees of *Acacia arabica* and *Dalbergia sissoo* were recorded and which was not flooded for more than 10 year.

Regarding the soil-plant relationships, it was noticed that *Tamarix* and *Calotropis* were more abundant on sandy-loamy soils and *Typha* more prevalent on clayey soils while *Saccharum* preferred sandy soils with freshly deposited clay in the upper layers.

These flood plains can be put under regular agriculture or changed into rangelands, if proper soil conservation and flood control measures are taken.

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