

# CLASSIFICATION OF PLANT COMMUNITIES IN FAISALABAD DISTRICT, PUNJAB, PAKISTAN, AND THE INFLUENCE OF ENVIRONMENTAL VARIABLES ON THEIR DISTRIBUTION

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## Abstract

The present study provides information about soil and water characteristics, floral composition and plant communities in Faisalabad District. An inventory of the study area's vegetation was prepared and physical and chemical characteristics of soil and water samples were analyzed. The relationship of environmental factors in the distribution of plant communities was determined. For statistical analysis of the data multivariate techniques i.e., Two Way Indicator Species Analysis and Canonical Correspondence Analysis were used. In total 48 species related to 31 families were recorded. Most abundant species were *Cynodon Dactylon*, *Salvia plebeian*, *Calotropis Procera*, *Ficus Religiosa* and *Melia Azedarach*. For analysis of floristic data Two Way Indicator Species Analysis (TWINSPAN) and to determine relationship between vegetation distribution and environmental parameters Canonical Correspondence Analysis (CCA) was applied. TWINSPAN classified the vegetation into 2 major and six minor communities whereas CCA analysis reflected that water EC, water pH and soil pH played significant role in controlling plant distribution.

**Keywords:** Plant communities, Faisalabad, Environmental Influence, TWINSPAN

## Introduction

Vegetation of an area not only provides ground cover to prevent soil erosion but also plays important role in maintaining ecosystem thriving there. Plants effectively stabilize soil and prevent loss of fertile top soil by avoiding direct impact of wind and water on it. Vegetation also provides habitat for wild life. Negative activities of human beings results in its rapid decline (Wilson, 1988). Soil serves as a medium for plants to anchor and get nutrients. It is made of minerals and organic matter so it is an important resource for plants (Sideris, 2008). Utilization of ordination techniques in research work in the field of vegetation ecology, involving study of distribution of plant communities and role of environmental factors in plant distribution, has become popular among ecologists these days. Classification of vegetation communities depends on

abundance of plant species (Zhang *et al.*, 2006). There are many examples in literature that show the utilization of multivariate techniques in data analysis. Various studies on environment plant relationships have been carried out in Egypt (Abd El-Ghani and Amer, 2003; Abd El-Ghani and El-Sawaf, 2005), Iran (Jafari *et al.*, 2004), Japan (Rogel *et al.*, 2001), USA (Omer, 2004) and Australia (Bui and Henderson, 2003). Results of these studies show that soil moisture content and nutrients play significant role in determining vegetation distribution (Rogel *et al.*, 2001).

The aim of the present investigation was to identify and classify the vegetation of the study area and to determine role of environmental factors in plant species distribution. It was achieved by utilizing ordination techniques of TWINSPAN and CCA.

## Materials and Methods

### Study area:

The study was conducted from February to May, 2016 in Faisalabad District. Faisalabad is located at 31°32'508"N and 73°06'849"E at an elevation of 182m above sea level. The districts of Hafizabad and Chiniot are in the North of Faisalabad, Sahiwal and Toba Tek Singh in the South, Nankana Sahib in the East and Jhang on the West. There are no natural boundaries between Faisalabad and adjoining districts. The Chenab River flows through it in the North-West while the River Ravi passes through the District in South-East. Faisalabad spreads mainly in the Old River Terraces –Sandal Bar and adjacent Plains of Ravi. Soil of the area made of mixed river alluvium, is brown to dark yellowish brown in colour. It has deep, mostly silty and loamy soils.

### Data Collection:

Several field trips were made for plant collection. Data collection was carried out by using quadrat method. For vegetation sampling a large representative area (100m<sup>2</sup>) was selected at each sampling site and quadrat was chosen randomly. The number of quadrat studied depended upon the

composition of plant community. Percentage cover values were recorded by visual estimation from each quadrat using the Domin Scale (Kent and Coker, 1995). Forty quadrats of 1x1m<sup>2</sup> for grasses, 2x2 m<sup>2</sup> for shrubs and 5x5 m<sup>2</sup> for trees were randomly laid down. Data was utilized for determining plant communities' composition. Collected plant specimens were properly preserved, identified and submitted in Samanabad College (W) Herbarium. The flora of Pakistan was consulted for plant identification (Nasir and Rafique, 1995).

#### Soil and Water Samples Analysis:

Soil samples (Composite surface 0-15cm depth) were taken by using barrel type hand auger from each quadrat as much of the nutrients uptake by plants take place from this depth (Allen, 1989). Various physical and chemical parameters were tested e.g., EC, pH, moisture content, colour etc. (Allen and Stainer, 1974). During vegetation survey, the ground water depth was measured and water samples were collected in PET bottles from the hand pump or open well/tube well. Similarly water samples were analyzed for water table depth, pH and EC.

#### Statistical Analysis:

Data was analyzed by Tow Way Indicator Species Analysis (TWINSPAN) to classify the plant communities. Species cover values were utilized to identify various communities. These studies were made up to 2 cut levels. For determining the relationship of environmental factors and plant distribution at Faisalabad District Canonical Correspondence Analysis (CCA) was used.

## Results and Discussion

### TWINSPAN Analysis of Species Data Recorded from Faisalabad

The flora at different selected sites of the study area was divided into two main groups, named as group A and Group B. Group A was further divided into six sub groups A1 to A6. Group B was not divided into sub groups as it consists of a small number of species. These divisions can be observed in Figure 1, which identifies various communities. Starting from the right side of the figure, there is community A, which has two dominant plant species, *Cynodon dactylon* and *Salvia plebeian* (community named as *Cynodon-Salvia*). In community B *Calotropis procera* and *Chenopodium album* are the dominant species (together named as *Calotropis-Chenopodium*). Coroi *et al.* (2004) carried out a study in Ireland using TWINSPAN to classify the vegetation of a streamside forest and identified five vegetation types.

In sub community A1 the most abundant species were *Salvia plebeia* and *Dichanthium annulatum*.

Therefore, this community was named *Salvia-Dichanthium*. This sub community was mostly present around the cultivated fields in Awagut, a rural area near Faisalabad city. These sites because of being in depression, received runoff water and fertilizers from adjacent fields.

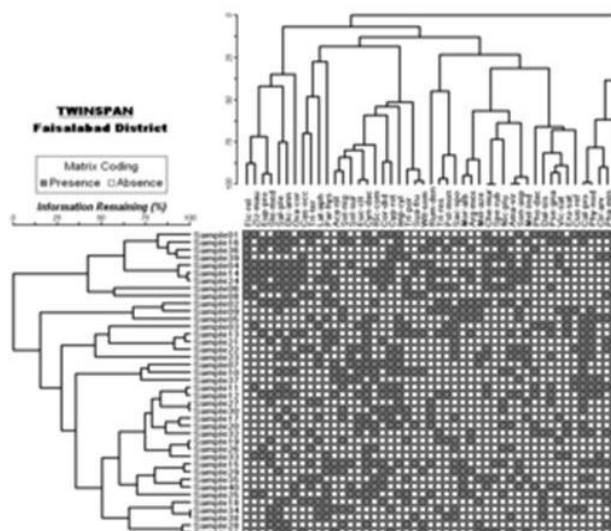
*Parthenium hysterophorus* and *Lathyrus aphaca* had similar abundance in A2 community (named as *Parthenium-Lathyrus*). It was a very small group of species that appeared only in 30 quadrats at Bangawala study area and the environmental conditions in these quadrats favored the existence of *Parthenium hysterophorus* and *Lathyrus aphaca* as disturbed habitat indicator species e.g., margins of agricultural field, roads, overgrazed areas, waste lands etc. (Martin *et al.*, 1951).

Community A3 was dominated by *Cynodon dactylon* and *Cyperus rotundus* was named as *Cynodon-Cyperus*. This community was found growing along road from Samundri to Faisalabad. *Cynodon dactylon* can survive on all types of soil and withstand grazing pressure so showed dominance in this community.

Community A4 had two dominant species *Saccharum spontaneum* and *Rumex dentatus* and was named *Saccharum-Rumex*. It was a small sub-community occurring in only few quadrats at wastelands and croplands margins of Chak Jumra.

The dominant species of community A5 and A6 were *Amaranthus viridis* and *Chenopodium murale*; *Pseudognaphalium luteoalbum* and *Vicia sativa*. They were named *Amaranthus-Chenopodium* and *Pseudognaphalium-Vicia* respectively. A5 sub-community was comprised of dominating herbs and scanty tree species. It comprised of nine species, among which the *Amaranthus viridis* and *Chenopodium murale* showed maximum percentage cover values, appearing in more quadrats compare to other species in the sampling region of Sattaina. This group was found growing on sides of roads, cultivated fields and waste lands.

The exclusive species A6 sub- community, *Pseudognaphalium luteoalbum* and *Vicia sativa*, had highest frequency values of 27.5 % and 25 % respectively and marked their presence in twenty one quadrats, studied near cultivated fields, roads and waste lands at Baluana study site.



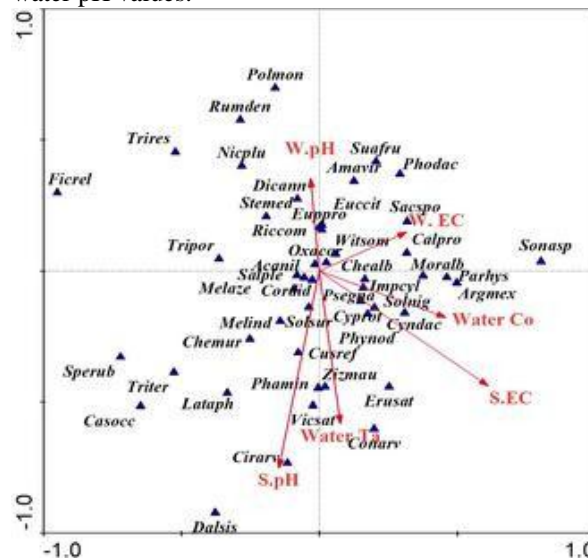
**Fig. 1.** TWINSpan Analysis of Species at Faisalabad District

**Group B** *Calotropis procera* and *Chenopodium album*, named as *Calotropis-Chenopodium* because of greater presence and percentage cover values of these species in the area. This community consisting of only six species was not divided further into sub groups. All plants of this community were herbaceous that were grouped together because of similar ecological requirements. The quadrats studied at Shaianwala area showed presence of this community. Species part of this community was *Calotropis procera*, *Cirsium arvensis*, *Chenopodium album*, *Convolvulus arvensis*, *Phyla nodiflora* and *Phalaris minor*.

**CCA Analysis of Plant and Environmental Data:**

CCA, an ordination technique was used in this study to develop a relationship between the flora and environmental variables of the study area. It indicates the reasons of occurrence or absence of the plant species in response to various physical and chemical parameters of soil and water. Several ecological parameters were considered in determining plant communities' response in terms of distribution to them. Triangles in the biplot represent the individual species while arrows show the extent of variations in the soil and water parameters. The longer the arrow, the greater its effect will be on vegetation. In present study, biplot graph obtained showed most of the species distributed in center of figure, indicating environmental parameters not having significant role in species distribution. Environmental variables, with their arrows pointing in same directions were strongly correlated. Water EC appeared to have some part in grouping of *Saccharum spontaneum* and *Calotropis*

*procera* as these species were closely located to this arrow. While *Vicia sativa* and *Convolvulus arvensis* showed correlation with water table arrow. Soil pH, displayed strong correlation with axis 1 and *Cirsium arvensis* located near Soil pH arrow indicates its specific requirements for soil pH. Similarly *Stellaria media*, *Dichanthium annulatum* and *Euphorbia prostrata* appeared to be sensitive for water pH values.



**Fig.2.** Biplot Diagram of Species Depicting Environmental Variables for Faisalabad

Bibi (2022) carried out a study in order to explore the flora of Lower Tanawal, Pakistan. They also utilized ordination techniques Two-Way Indicator Species Analysis (TWINSpan) and Canonical Correspondence Analysis (CAA) as were used in present study for statistical analysis. During this study 165 species and 24 stands were classified into four plant communities. Similarly in another study conducted by Waheed *et al.*, (2024) vegetation diversity and environmental factors that influence plant distribution were studied in Kala Chitta National Park of Pakistan. There findings were in accordance with present study and it was discovered that plant communities are dependent on ecological factors for their distribution and abundance.

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