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***Full Length Article***

# Vegetation Dynamics of Anthropogenically Disturbed Ecosystem in Hilly Areas around Sargodha, Pakistan

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## Abstract

Present study has been conducted in order to evaluate the effects of different anthropogenic disturbances (stone crushing, grazing and cutting of trees for fuel) on the growth and development of different plant communities in disturbed ecosystem of Karana Hills near Sargodha. The data for density, frequency, cover and other derived parameters was collected using fixed quadrate method and analyzed by using canonical correspondence analysis technique. It was concluded that 80% disturbance was caused by stone crushing, 10% disturbance by grazing and 5% disturbance by harvesting and remaining by fire with other factors. Environmental factors significantly affect the growth as well as distributional pattern of the native plant species. Anthropogenic activities, especially stone crushing significantly affect community structure and composition, and distributional pattern as more stress tolerant species replace the sensitive ones. © 2016 Friends Science Publishers

**Keywords:** Community structure; Dust pollution; Ecosystem; Hilly areas; Vegetation dynamics

## Introduction

Anthropogenic activities like land development directly influence natural plant communities causing injuries to plants or loss of habitat (Wijayratne *et al*., 2009) and simultaneously have many indirect effects. Among indirect effects the most serious is atmospheric dust that can seriously hamper structural and functional activities of native plants (Belnap and Warren, 2002). Dust pollution blocks stomata, increases chlorophyll pigments and this ultimately drastically effects growth (Farmer, 1993; Prajapati, 2012).

Vegetation plays a critical role in regulating climatic gases and temperature. Soil physico-chemical features like soil volume, ionic content, structure and texture are affected by loss of vegetation (Bonifacio *et al*., 2008). Anthropogenic activities like stone crushing are seriously affecting not only local human population, but also damaging plants and plant communities. It is very important to study vegetation dynamics in disturbed and undisturbed areas in the Kirana hills in the vicinity of Sargodha to evaluate impact of dust pollution due to human activities. Kirana Hills are a small range of continuous, discontinuous and scattered mountains about 40 miles long covering an area of 1980 km$^2$. Geographically, these are located from District Sargodha to District Chiniot, in central region of Pakistan's province Punjab. Koh-e-Kirana is apex in Kirana hills with a maximum height of 440 m, locally called as Black Mountain. It is situated between 31°58' 39.53"-31° 53' 22.38" N and 72° 41' 15.56"-72° 43' 14.69" E. The temperature varies from 2°C in winters to 51.4°C in summer, which rarely exceed to 59°C, annual rainfall of about 285 mm. Land surrounding the hills is fertile and quite suitable for kinnow mandarin (*Citrus reticulata*) cultivation. Other crops like wheat, maize, barley and few others are also cultivated. Much of the land is also affected by high salinity and/or water logging (Khan *et al*., 2009).

Kirana hills was previously explored for collecting data about volcanic eruptions and mining activities for minerals and ores present in the area, and for this reason nuclear laboratory is established there. However, the vegetation component of this unique area was totally ignored. In previous decades, Kirana hills were rich in dense bushes, herbs and weeds as well as non-woody plants. In fenced prohibited area under army control, vegetation cover is quite dense and with rich plant diversity. Commonly occurring species are *Acacia modesta*, *Prosopis glandlosa* and quite a few shrubs and many grasses. The disturbed area where stone crushing activities are common, vegetation is badly affected and species like *Fagonia indica*, *Aristida mutabilis*, *Boerhavia diffusa*, *Convolvulus arvensis* and *Aerva javanica* are dominant, which are resistant to a variety of environments, in particular deserts and semi-deserts.

Plant population, growth, development and biomass have extremely disturbed due to various anthropogenic factors other than stone crushing in Kirana Hills, which include fire, grazing and cutting trees. These effects involve

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both direct via habitat loss and mechanical damage to native vegetation and indirect by dust pollution that is seriously affecting both local population and vegetation. Rocks are exploded for stone crushing that releases hazardous chemicals into the environment. Microorganisms of great biological significance, living in roots of plants are wasted in this process (Strohbach, 2008).

Dust has a direct impact on structural and functional features of plant, closes stomata that negatively affects gas exchange parameters, especially photosynthesis. This ultimately weakens the plants, which consequently die away and disturb the ecosystem (Prajapati, 2012). Widely differing phytotoxic responses are observed when plants exposed to a given mass concentration of dust particles; size is related to mode and magnitude of deposition (Whitby, 1978). Heavy traffic load is also too high on the nearby roads of Kirana hills. Air pollutants like $SO_2$, $CO_2$, CO and NOx produce in burning of vehicle fuel along with heavy metals like lead. Mineral dusts are less soluble, less reactive than the anthropogenic acid-forming $SO^{-4}$ and $NO^{-3}$ particles (Grantz *et al*., 2003).

Dust and pollutant mixture with pH<9 may cause direct injury to leaf tissues on which they are deposited (Vardak *et al*., 1995) or indirectly through change of soil pH (Hope *et al*., 2001). Dust containing pollutants (especially lead) had adverse effects on vegetation (Prajapati and Tripathi, 2008). Leaf temperature also rises due to dust pollution, which effects transpiration rate in plants and this may lead to drought sensitivity (Sharifi *et al*., 1997).

The herbivores are important agents of change in vegetation, acting to create spatial diversity, modifying succession, and controlling the switching of ecosystems between alternative states (Hobbs, 1996). Augustine and McNaughton (1998) reviewed studies of ungulate effects to gain insights about potential mechanisms of ungulate-induced changes in plant community composition and ecosystem processes. An increase in human population decreases residential facilities and therefore deforestation and destruction of vegetation become essential (Stenhouse, 2004). Life cycles of many plant species are also affected because of the elimination of insect pollinators, in particular butterflies (Kadlec *et al*., 2008) and consequently plant community structure is disturbed. Keeping these facts in view the present study was planned to determine the plant diversity of the area, effects of anthropogenic disturbances on different plant species and to observe the seasonal variations in the plant community structure of the area.

## Material and Methods

This research project was carried out to analyze the vegetation dynamic of anthropogenically disturbed ecosystem of Kirana Hills, located between district Sargodha and Chiniot in Punjab Pakistan. The studies were conducted during 2012 and 2013, to determine the distribution pattern and growth of vegetation, plant diversity, plant community, frequency, density and dominancy at 6 different sites and all 4 seasons. It was managed to assess the effects of major disturbance causing sources such as stone crushing industry, plant cutting for fuels and animal grazing on local vegetation. The main focus was on the identification of anthropogenic disturbances and the threats of anthropogenic activities on native vegetation.

### Selection of Sites

Hilly area from Chak 111 (about 15 km from Sargodha on road to Faisalabad) to Chak 46 (about 24 km from Sargodha) is covered under studies, which is about 20 km long (meterological data of the Kirana Hills are presented in Table 1). On the basis of a preliminary survey, five ecologically diverse study sites namely Site-1, Site-2, Site-3, Site-4 and Site-5 were selected keeping in view the differences in environmental attributes especially variation in elevation, altitude, slope, topography, soil composition, vegetation types and plant community (Ahmad *et al*., 2012). Geographical data are presented in Table 2. The data will be collected in all 4 seasons i.e., spring (January to March), summer (April to June), autumn (July to September) and winter (October to December).

### Ecological Analysis of the Vegetation

The plants species were counted from their natural habitats at different sites in Kirana Hills during all the four seasons. For autumn, winter, spring and summer, the ecological data were recorded during last weeks of September, December, March and June, respectively. The plants were identified from the Herbarium, Department of Botany, University, Agriculture, where all the voucher specimens were deposited.

Ecological data were recorded using quadrate sampling method. Fixed quadrate of 1 $m^2$ was used and all individual plants, herbs, shrubs, grasses in the quadrates were counted. At each site 10 quadrates were taken where more diversity present. Data recorded were used for the calculation and evaluation of density, frequency, percent cover, relative density, relative frequency, relative coverage/dominance, importance value, classification of species following Ahmad *et al*. (2012).

### Identification of Anthropogenic Threats to Plant Diversity

Threats to plant diversity were identified through following steps:

1. Through interviews of local residents, especially aged persons having traditional knowledge of plants.
2. Conversation with owners and workers of stone crushing industry, truck drivers, etc.
3. Discussion with government officials, public representatives, press reporters, etc.
4. Through personnel observations.

**Table 1:** Meteorological data of different seasons in the Kirana Hills in Punjab

| Season | Temperature (°C) | | Rainfall (mm) |
|---|---|---|---|
| | Maximum | Minimum | |
| Autumn 2012 | 39.4 | 12.2 | 300 |
| Winter 2012 | 25.1 | 2.3 | 290 |
| Spring 2013 | 29.4 | 5.0 | 280 |
| Summer 2013 | 59.1 | 18.3 | 320 |

**Table 2:** Geographical aspects of the sites selected in Kirana Hills in Punjab

| Sites | Coordinates | Elevation (feet) | Slope (%) | Aspect |
|---|---|---|---|---|
| Site-1 | 31.90°N and 72.67°E | 237 | 30-35 | Western |
| Site-2 | 31.85°N and 72.65°E | 243 | 25-45 | Northern |
| Site-3 | 31.81°N and 72.60°E | 249 | 35-40 | Western |
| Site-4 | 31.78°N and 72.58°E | 259 | 50-75 | Northern |
| Site-5 | 31.78°N and 72.58°E | 252 | 25-35 | Eastern |

### Soil Analysis

Soil texture was analysis by using hygrometer method (Dewis and Freitas, 1970). Electrical conductivity, pH and ions of saturation extracts were determined according to Jackson (1962) and Rhoades (1982).

### Statistical Analysis

Community structure was determined by using TWINSPAN (two-way indicator species analysis) in computer software Community Analysis Pakage 5.0. Partial CCA (canonical correspondence analysis) was analyzed by Canoco 4.5 ecological software.

## Results

In the study sites, plant species belonging to 15 families were recorded, the maximum species were recorded in family Poaceae, in which 10 species were found (Table 5). It was followed by Amaranthaceae and Asteraceae, containing 3 species each. Capparidaceae, Convolvulaceae and Zygophyllaceae had two species each, and the rest contained one each.

Community structure was identified by using TWINSPAN ecological software. In Site-1, the dominant plants were *F. indica* and *A. mutabilis*, whereas Site-2 was dominated by *B. diffusa* community (Table 3). In Site-3 the dominant plants were *A. javanica* and *A. adscensionis* and in Site-4 *C. arvensis* dominated the area. In Site-5, the dominant plants were *A. adscensionis*. However, there is a variation in vegetation structure during different seasons, particularly of the ephemeral or annual species.

There was a significant variation in soil physico-chemical characteristics round the year. Saturation varied slightly at all sites except at Site-4, where this parameter changed from 30-36% in winter and summer (Table 4). Soil ECe significantly varied, not only at different sites, but

**Table 3:** Plant community structure of the sites in the Kirana Hills in Punjab

| Sites | Habitat Description | Vegetation Type | Plant Community |
|---|---|---|---|
| Site-1 | Moderate slopes | Dominant large bushes with grasses | *Fagonia indica* and *Aristida mutabilis* |
| Site-2 | Hills with steep slopes | Shrubs herbs and grasses | *Boerhavia diffusa* |
| Site-3 | Almost Plain area | Shrubs and grasses | *Aerva javanica* and *Aristida adscensionis* |
| Site-4 | Hills with highly steep slopes | Dominant grasses with shrubs | *Convolvulus arvensis* |
| Site-5 | Somewhat plain area | Mixture of herbs grasses | *Aristida adscensionis* |

**Table 4:** Soil characteristics of the sites selected in the Kirana Hills in Punjab

| Characteristics | | Sites | | | | |
|---|---|---|---|---|---|---|
| Saturation (%) | Seasons | Site-1 | Site-2 | Site-3 | Site-4 | Site-5 |
| | Autumn | 30 | 30 | 30 | 32 | 32 |
| | Winter | 30 | 30 | 36 | 32 | 32 |
| | Spring | 32 | 30 | 30 | 30 | 30 |
| | Summer | 30 | 34 | 36 | 30 | 30 |
| Soil ECe (mS $cm^{-1}$) | Autumn | 4.67 | 1.14 | 7.08 | 1.37 | 1.83 |
| | Winter | 1.20 | 1.63 | 9.49 | 1.81 | 1.75 |
| | Spring | 5.12 | 2.82 | 10.41 | 2.64 | 1.96 |
| | Summer | 1.96 | 1.27 | 8.75 | 1.32 | 2.01 |
| Soil pH | Autumn | 7.7 | 8.2 | 7.7 | 8 | 8 |
| | Winter | 8.1 | 8 | 7.2 | 8 | 8.2 |
| | Spring | 7.6 | 7.7 | 7.4 | 8.1 | 6.7 |
| | Summer | 7.5 | 8.2 | 8 | 8.1 | 7.9 |
| Organic Matter (%) | Autumn | 0.34 | 0.34 | 1.39 | 0.90 | 0.34 |
| | Winter | 0.34 | 0.34 | 0.34 | 1.39 | 0.69 |
| | Spring | 0.34 | 0.34 | 1.46 | 0.69 | 0.48 |
| | Summer | 0.20 | 1.81 | 1.39 | 1.95 | 0.55 |
| P (mg $kg^{-1}$ dry soil) | Autumn | 3.9 | 2.9 | 5.9 | 4.3 | 2.6 |
| | Winter | 3.4 | 4.9 | 3.1 | 3.8 | 5.1 |
| | Spring | 2.8 | 1.7 | 4.7 | 3.6 | 4.3 |
| | Summer | 6.4 | 6.8 | 11.3 | 4.8 | 10.5 |
| $K^+$ (mg $kg^{-1}$ dry soil) | Autumn | 108 | 124 | 100 | 96 | 124 |
| | Winter | 112 | 130 | 136 | 106 | 176 |
| | Spring | 92 | 118 | 120 | 116 | 138 |
| | Summer | 108 | 102 | 252 | 154 | 164 |

also during different seasons. Site-3 was the most saline, where it changed from 7.08 (autumn) to 10.41 mS $cm^{-1}$ (spring). Soil ECe at Site-1 was changed from 1.20 (winter) to 5.12 mS $cm^{-1}$ (spring). Soil pH not much varied at different sites of during different seasons, but at Site-5, this parameter was change from 6.7 (spring) to 8.2 (winter). Soil organic matter greatly varied along different sites and during different seasons (Table 4). This parameter varied from 0.34 to 1.81 at Site-2, from 0.34 to 1.46 at Site-3, and from 0.69 to 1.95 at Site-4. Variation was relatively high for soil P during different seasons. Soil P varied from 3.1 (winter) to 11.3 mg $kg^{-1}$ (summer) at Site-3 and from 2.6 (autumn) to 10.5 mg $kg^{-1}$ (summer) at Site-5. The maximum variation for soil $K^+$ was recorded at Site-4, where this parameter varied from 96 (autumn) to 154 mg $kg^{-1}$ (summer).

Partial CCA analysis showed a definite relationship of plant species with the study sites during different seasons. Relative density of Car was strongly associated with Site-4

**Table 5:** List of plant species recorded from Kirana Hills

| Family | Plant species |
|---|---|
| Amaranthaceae | *Aerva javanica (Aja), Salsola imbricata (Sim), Suaedavera (Sfr),* |
| Asclepiadaceae | *Calotropis procera (Cpr)* |
| Asteraceae | *Cirsium arvense (Car), Echinops echinatus (Eec), Senecio vulgaris (Svu)* |
| Boraginaceae | *Trichodesmai ndicum (Tin)* |
| Capparidaceae | *Cleome brachycarpa (Cbr), Cleome scaposa (Csc)* |
| Caryophyllaceae | *Spergula arvensis (Sar)* |
| Convolvulaceae | *Convolvulus arvensis (Cav), Convolvulus desertii (Cde)* |
| Cucurbitaceae | *Citrullus vulgaris (Cvu)* |
| Fabaceae | *Acacia modesta (Amo)* |
| Nyctaginaceae | *Boerhavia diffusa (Bdi)* |
| Poaceae | *Aeluropusl agopoides (Ala), Aristida adscensionis (Aad), Aristida mutabelis (Amu), Arun dodonax (Ado), Brachiaria eruciformis (Ber), Cenchrus ciliaris (Cci), Cymbopogon jwarancusa (Cjw), Dactyloctenium aegyptium (Dae), Dichanthium annulatum (Dan), Stipagrostis plumosa (Spl)* |
| Portulacaceae | *Portulaca quadrifida (Pqu)* |
| Solanaceae | *Solanum surretens (Ssu)* |
| Tamaricaceae | *Tamarix aphylla (Tap)* |
| Zygophyllaceae | *Fagonia indica (Fin), Peganum harmala (Pha)* |

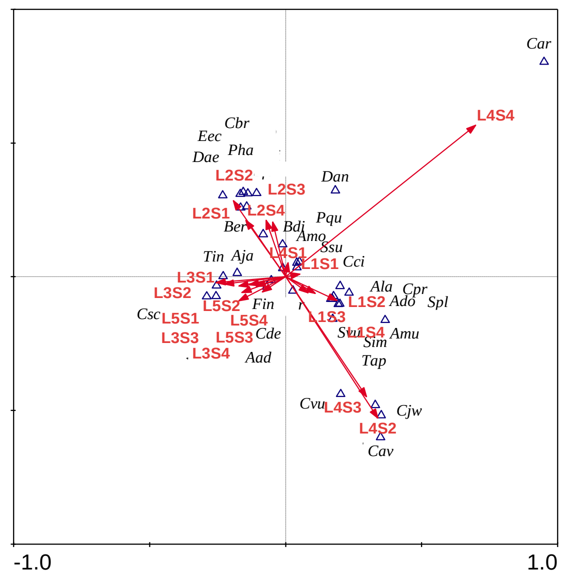


**Fig. 1:** Partial CCA ordination biplot showing the effects of seasons and locations on species relative density in the Kirana Hills

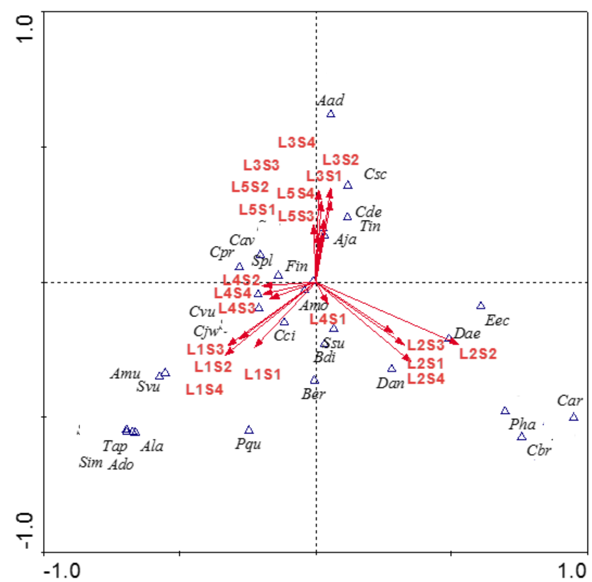


**Fig. 2:** Partial CCA ordination biplot showing the effects of seasons and locations on species relative frequency in the Kirana Hills

during summer (Fig. 1), whereas Site-4 was associated with Cjw, Aav and Cvu during winter and spring. A strong relationship was recorded for Site-2 with Ber, Dae and Eec during autumn and winter, while with Cbr, Pha and Bdi during spring and summer. Site-1 was associated with Ala, Cpr, Ado, Spi, Smi, Amu, Sim and Tap during winter, spring and summer regarding relative density.

Relative frequency showed 4 distinct groups of associations (Fig. 2). In first group, Site-3 and Site-5 with Aja, Tin, Cde, Csc and Aad during all 4 seasons. The second group showed a close relationship of Site-2 with Dae, Eec, Dan, Pha, Cbr and Car round the year. On third group, Site-1 was strongly correlated with Cjw, Amu, Svu, Tap, Sim, Ado, Ala and Cci throughout the year. The last group showed a relationship of Site-4 with Cpr, Cav, Cvu, Spl and Fin during winter, spring and summer.

Relative cover showed two distinct groups for species association (Fig. 3). In the first group, Site-2 is strongly associated with Dan, Dae, Eec, Pha, Cbr and Car during all 4 seasons. In the second group, Site-1 was strongly correlated with Amu, Tap, Sim, Ado, Ala and Cci round the year. There was a strong association of Site-3 and Site-5 with Aja, Tin, Cde, Csc and Aad.

Importance value showed three distinct clusters on the basis of partial CCA (Fig. 4). In the first cluster, Site-3 and Site-5 were strongly associated with Tin, Aja, Csc, Aad, Sfr, Cvu and Cde during all 4 seasons. In the second group, ite-2 was associated with Eec, Dae, Car and Pha round the year. The third cluster showed a close association of Site-1 and Site-4 with Ala, Ado, Tap, Sim, Amu, Svu, Cjw, Cav, Cpr,

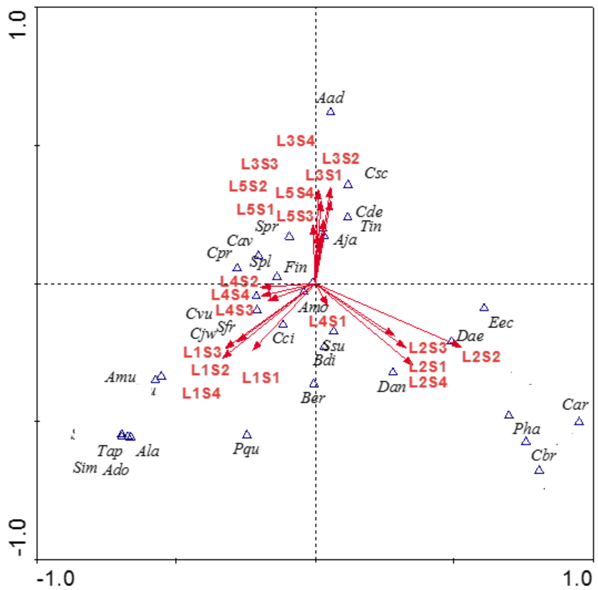


**Fig. 3:** Partial CCA ordination biplot showing the effects of seasons and locations on species relative cover in the Kirana Hills

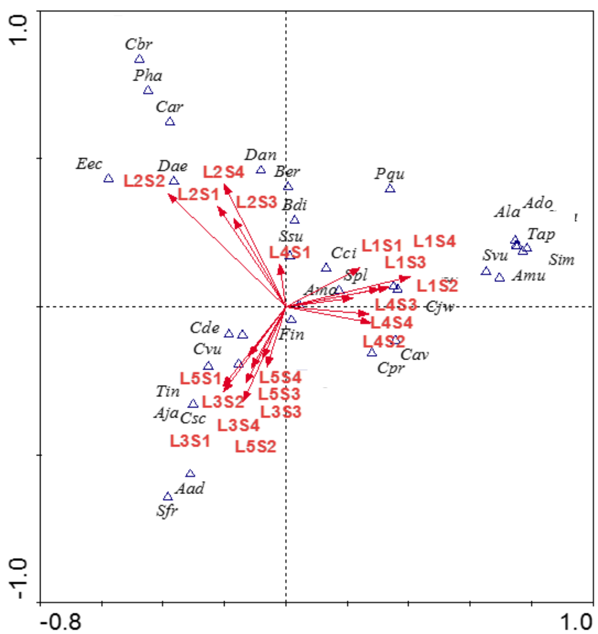


**Fig. 4:** Partial CCA ordination biplot showing the effects of seasons and locations on species importance value in the Kirana Hills

Ama and Spl.

## Discussion

Vegetation dynamics have been discussed on the basis of relationship between vegetation types, elevation, soil composition and soil mineral contents whereas the seasonal variations in plant diversity were related to rainfall, maximum and minimum temperature and availability of different nutrients during different seasons. Among the environmental factors affecting on the vegetation of an area, the moisture in the soil resulting from rainfall was the most important factor for plant growth (Podleśny and Podleśna, 2011) and distribution of species (Amissah *et al.*, 2014), which was also controlled by soil composition, soil type and mineral nutrients of soil. The results of present study are in accordance with Karr and Roth (1971), Smitheman and Perry (1990) who supported the criteria mentioned above, investigated and described the plant communities of different areas of the world.

Soil pH is considered a master variable in soils as it controls many chemical processes to take place. pH changes round the year but high in winter. It specifically affects plant nutrient availability by controlling the chemical forms of the nutrient. Plants grown in acidic soils (pH<7) can experience a variety of symptoms including aluminium (Al), hydrogen (H), and manganese (Mn) toxicity, as well as potential nutrient deficiencies of $Ca^{2+}$ and $Mg^{2+}$ (Brady and Wiel, 2002; Hansson *et al.*, 2011). In slightly too moderately alkaline soils (pH 7–8), molybdenum and macronutrient (except for phosphorus) availability is increased, but at higher pH. The availability of nutrients like P, Fe, Mn, Zn Cu and Co levels significantly reduces and may adversely affect plant growth (Marschner, 1990).

Most of the salt tolerant species such as *F. indica* and *A. adscensionisis* were distributed around saline soils of Site-1 and Site-5. Naz *et al.* (2010) reported that these species confined to saline habitats in the Cholistan Desert. It also had high field capacity, which helps to maintain more moisture even without heavy rains. Most of the herbs and shrubs were distributed around Site-4, which had soil layer thick surface and grazing is the common threat and *Convolvulus* species are mostly very sensitive to grazing, whereas grasses are generally resistant to over-grazing (McNaughton, 1993). Some species were associated with Site-3 as macronutrients and field capacity was more associated with this site. *Echinops ritro, Peganum harmala and Cirsium arvense* were entirely associated with Site-2 as these species are mostly found at high moisture containing sites and dry spell is a threat for these species. Moreover enough macronutrients were also available at Site-2 essential for maximum growth of herbs (Ahmed *et al.*, 2011).

The largest numbers of species are associated around Site-4 and Site-5 due to their requirement for macronutrients. Most of the species were more frequent around Site-4 and Site-5 due to its association with macronutrients and high field capacity (Ahmed *et al.*, 2011). Salt and drought tolerant species are associated around Site-3. Moisture loving and moderate moisture requiring species are associated with and equally between the Site-1 andSite-4. From the results it can be concluded that *A. adscensionis* is the most abundant species in the Site-5. The reason being is its adaptation to the osmotic adjustments under various types of environments (Soumana *et al*., 2014).

It is clear that inhabitants of the area are well aware of the fact that natural resources particularly medicinal plants of the valley are diminishing with alarming rate but do not have enough resources to save this loss. However, according to 80% respondents, stone crushing, 10% over grazing and 5% continuous cutting for various purposes particularly fuel and fodder, 5% less rain fall are responsible for reduction in plants biodiversity of the area. Lowering of water table is also considered as one of the major causes of reduction in vegetation. Personal observation showed that continuous grazing and clear cutting for fuel and stone crushing industries are the main causes of reduction in plants community. One of the major threats posed by human activities in Kirana Hill is the increased human population which has increased pressure on all natural resources particularly on species responsible for food, fuel, forage and medicine (Hussain, 2002). Reduction in rainfall and rise in temperature lowered the water level of hilly area causing severe impacts on the vegetation of the area. Large number of species living in the lower parts particularly is vulnerable to salinization. In different parts of the world large number of the natural plant species is threatened with extinction because of arid land salinity (Keighery, 2000).

Overgrazing is perhaps the most serious threat to large number of plant species in the area, as the people in the valley are poor and mainly depend upon animals for their earning. Extensive grazing accompanied by aridity in the area accelerated the erosion process. Many reports sport the above findings (Macias and Royes, 2002).

Over-harvesting of different plant species particularly herbaceous plants has also become a severe threat to herbs plant diversity. Kaimowitz (2003) reported that forest resources play important role to rural livelihood which become a threat and causes loss of important plant species. Low rain fall in recent years also played a role in less growth of forests. Therefore it can be concluded that forests were affected due to biotic and abiotic factors. Rouget *et al*. (2003) identified three important factors that threaten the biodiversity, as cultivation of intensive agriculture, urbanization and stands of invasive alien trees and shrubs. In Kirana Hills, biotic factors strongly interfere with the forests but its impacts are greater in the open-to-excess areas than the protected areas. The protected areas in most of the cases are badly invaded by the invasive introduced species e.g. *Portulaca quadrifida* species introduced in the Site-1, is threatening the existence of important local vegetation particularly medicinal flora, in the protected area (Ahmad and Waseem, 2004). A thick coat of dust was always found on leaf surface of plants in site-1. Prajapati and Tripathi (2008) studied dust interception efficiency of some selected tree species and found that all species have maximum dust deposition in winter followed by summer and rainy season.

From the above discussion it clear that stone crushing, population pressure, low rain fall, soil aridity, over grazing, deforestation and natural and accidental fires are the main threats to biodiversity in area. If the local peoples were not provided alternate of these problems the prevailing disturbances will soon eliminate the remaining patches of vegetation particularly medicinal flora of the Kirana hills. Immediate and complete protection, efficient recovery system and effective community participation for long term conservation are essential for sustainable use of plant resources in the area. Similar suggestions were given by Hussain (2002) and Ahmad and Waseem (2004).

## Conclusion

Environmental factors significantly affect not only the growth of native plant species, but also the distributional pattern of plant species. Anthropogenic activities, especially stone crushing plays a critical role for community composition and structure, and distributional pattern, as more stress tolerant species replace the sensitive ones.

## References


Ahmad, H. and M. Waseem, 2004. Conservation status of some medicinal plants of the Salt Range. *Zonas Áridas,* 8: 1013–1044

Ahmad, I., M.S.A. Ahmad, M. Hameed, M. Hussain, M.Y. Ashraf, F. Ahmad and H. Malik, 2012. Status of plant diversity in the Soon Valley, salt range, Pakistan. *Pak. J. Bot*., 44: 59–62

Ahmed, F., S. Rehman, N. Ahmed, M. Hussain, A. Biswas, S. Sarkar, H. Banna, A. Khatun, M. H. Chowdhury and M. Rahmatullah, 2011. Evaluation of *Neolamarckia cadamba* (Roxb.) bosser leaf extract on glucose tolerance in glucose-induced hyperglycemic mice. *Afr. J. Tradit. Compl. Altern. Med*., 8: 79–81

Amissah, L., G.M.J. Mohren, F. Bongers, W.D. Hawthorne and L. Poorter, 2014. Rainfall and temperature affect tree species distribution in Ghana. *J. Trop. Ecol*., 30: 435–446

Augustine, D.J. and S.J. McNaughton, 1998. Ungulate effects on the functional species composition of plant communities: herbivore selectivity and plant tolerance. *J. Wildl. Manage*., 62: 1165–1183

Belnap, J. and S. Warren, 2002. Patton's tracks in the Mojave Desert, USA: An ecological legacy. *Arid Land Res. Manage*., 16: 245–258

Bonifacio, E., S. Santoni, P. Cudlin and E. Zanini, 2008. Effect of dominant ground vegetation on soil organic matter quality in a declining mountain spruce forest of central Europe. *Boreal Environ. Res*., 13: 113–120

Brady, N.C. and R.R. Wiel, 2002. The relationship between soil quality and crop productivity across three tillage systems in south central Honduras. *Amer. J. Alter. Agric*., 17: 2–8

Dewis, J. and F. Dewis, 1970. Physical and chemical methods of soil and water analysis. *Soils Bull*., 10: 32–63

Farmer, A.M., 1993. The effects of dust on vegetation-a review. *Environ. Pollut*., 79: 63–75

Grantz, D.A., J.H.B. Garner and D.W. Johnson, 2003. Ecological effects of particulate matter. *Environ. Int.,* 29: 213–239

Hansson, K., A.O. Bengt, O. Math and J. Ulf, 2011. Differences in soil properties in adjacent stands of Scots pine, Norway spruce and silver birch in SW Sweden. *For. Ecol. Manage*., 262: 522–530

Hobbs, N.T., 1996. Modification of Ecosystems by Ungulates. *J. Wildl. Manage*., 60: 695–713

Hope, D., S.M. Palmer, M.F. Billett and J.J.C. Dawson, 2001. Carbon dioxide and methane evasion from a temperate peatland stream. *Limnol. Oceanogr.,* 46: 847–857

Hussain, M., 2002. *Exploration of Legume Diversity Endemic to Salt Range*, in the Punjab Annual Technical report submitted to University of Agriculture Faisalabad, Pakistan

Jackson, M.L., 1962. Surface effects in a pulsed. *AIChE J*., 8: 659–662
Kadlec, T., J. Benes and V. Jarosik, 2008. Revisiting urban refuges: Changes of butterfly and burnet fauna in Prague reserves over three decades. *Landsc, Urban Plan*., 85: 1–11
Kaimowitz, D., 2003. Forest law enforcement and rural livelihoods. *Int. For. Rev*., 5: 199–210
Karr, J.R. and R.R. Roth, 1971. Vegetation structure and avian diversity in several New World areas. *Amer. Nat*., 105: 423–435
Keighery, G., 2000. Biological survey and setting priorities for flora conservation in Western Australia. *Aust. J. Bot*., 55: 308–315
Khan, Z.K., N. Ahsan, A. Mateen and M.N. Chaudhry, 2009. Petrography and mineralogy of dolerites of Hachi Volcanics Kirana Hills Area, Pakistan. *Geol. Bull. Punjab University*, 44: 55–67
Macias, C.G.V. and M.N. de Los Royes, 2002. Phylogenetic relationships in the cactus family (*Cactaceae*) based on evidence fromtrnK/matKandtrnL-trnF sequences. *Am. J. Bot*., 89: 312–326
Marschner, H., 1990. Mechanisms of adaptation of plants to acid soils. *In: Proceedings of the 2nd International Symposium on Plant-Soil Interactions at Low pH*, pp: 24–29. Beckley West Virginia, USA
McNaughton, S.J., 1993. Grasses and grazers, science and management. *Ecol. Appl*., 3: 17–20
Naz, N., M. Hameed, M.S.A. Ahmad, M. Ashraf and M. Arshad, 2010. Is soil salinity one of the major determinants of community structure under arid environments? *Commun. Ecol*., 11: 84–90
Podleśny, J. and A. Podleśna, 2011. Effect of rainfall amount and distribution on growth, development and yields of determinate and indeterminate cultivars of blue lupin. *Polish J. Agron*., 4: 16–22
Prajapati, S.K., 2012. Ecological effect of airborne particulate matter on plants. *Environ. Skeptics Critics*, 1: 12–22
Prajapati, S.K. and B.D. Tripathi, 2008. Assessing the genotoxicity of urban air pollutants in Varanasi City using *Tradescantia micronucleus* (Trad-MCN) bioassay. *Environ. Int*., 34: 1092–1096
Rhoades, J.D., 1982. Aluminum Solubility in Organic Soil Horizons from Northern and Southern Forested Watersheds. *Soil Sci. Soc. Am. J*., 54: 369–374
Rouget, M., D.M. Richardson, R.M. Cowling, Y.W. Lioyd and A.T. Lombard, 2003. Current pattern of habitat transformation and future threats to biodiversity in terrestrial ecosystem of the cape floristic region. *S. Afr. Biol. Conserv*., 112: 63–85
Sharifi, M.R., A.C. Gibson and P.W. Rundel, 1997. Surface dust impacts on gas exchange in Mojave Desert shrubs. *J. Appl. Ecol*., 34: 837–846
Smitheman, J. and P. Perry, 1990. A vegetation survey of the Karoo national botanic garden reserves Worcester. *S. Afr. J. Bot.*, 56: 525–541
Soumana, I., T. Abasse, M. Larwanou, B. Katkoré, B. Morou, D.I. Tahirou and A. Mahamane, 2014. Effects of physical and biological treatments in restoring degraded crusted soil in Niger. *Res. J. Agric. Environ. Manage*., 3: 560–568
Stenhouse, R.N., 2004. Embracing variability in the application of plant–soil interactions to the restoration of communities and ecosystems. *Estor. Ecol*., 16: 713–729
Strohbach, B., 2008. Tree species and diversity effects on soil water seepage in a tropical plantation. *For. Ecol. Manage*., 309: 76–86
Vardak, E., C.M. Cook and T. Lanaras, 1995. Effect of dust from a limestone quarry on the photosynthesis of *Quercus coccifera* and evergreen sclerophyllous shrub. *Environ. Contam. Toxicol*., 54: 414–419
Whitby, K.T., 1978. The physical characteristics of sulfur aerosols. *Atmos. Environ.*, 12: 135–159
Wijayratne, U.C., S.J. Scoles-Sciulla and L.A. Defalco. 2009. Dust deposition effects on growth and physiology of the endangered *Astragalus jaegerianus* (Fabaceae). *Madrono*, 56: 81–88

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