



ISSN NO. 2320-5407

Journal homepage: <http://www.journalijar.com>

INTERNATIONAL JOURNAL
OF ADVANCED RESEARCH

RESEARCH ARTICLE

"SOIL AND PLANT RELATION AT LITTLE RANN OF KUTCH OF GUJARAT IN WESTERN INDIA"

PILANIA P.K. and N.S. PANCHAL*

Department of Biosciences, Saurashtra University, Rajkot, (Gujarat) India

Manuscript Info

Manuscript History:

Received: 12 May 2014
Final Accepted: 23 June 2014
Published Online: July 2014

Key words:

Vegetation, Soil, Little Rann of Kutch, Distribution pattern

Corresponding Author

N.S. PANCHAL

Abstract

Vegetation and soil in the vicinity of Wild Ass Sanctuary of Kutch district of Gujarat State in India was investigated. This region is considered as a saline desert. Eight sites were studied and total seventeen species were found of which ten species of grasses, five of herbs, one of shrub and climber each. Ten species belongs to Poaceae and two belongs to Papilionaceae. Contagious distribution pattern of plants was obtained. Dominant species found were *Cressa cretica* Linn., and *Aeluropus lagopoides* (Linn.) Trin. ex Thw. at maximum sites. Different physical and chemical parameters of soil were investigated at different depths. A maximum and minimum value varies at different depth for both. Water holding, field capacity and porosity were found to be more at sites which contains high density which shows a positive effect on density of plants. Significant positive correlation coefficient was obtained for organic carbon, nitrogen, phosphorous with density while negative obtained for sodium. High salinity content in soil is harmful for plants and salt tolerated species should be grown for the increment of the floral diversity. The outcome of the study illustrate that physical and chemical properties of the soil confirm positive as well as negative consequence on vegetation and diverse species in saline area.

Copy Right, IJAR, 2014.. All rights reserved

Introduction

Little Rann of Kutch (LRK) is a unique geographical location surrounded by water and Saline desert. It is well known as The Wild Ass Sanctuary, named after endangered Ghudkhur (*Equus hemionus khur*) which is established in 1972 and protected under the Wildlife Protection Act, 1973. It is situated between 22° 55" to 24° 35" North latitudes and 70° 30" to 71° 45" East longitudes. It possesses unique components of both flora and fauna. It is considered as a large ecotone, a transitional area between marine and terrestrial ecosystems. According to Red Data Book of Indian plants, many rare and narrow populations of plants species of Gujarat are found in Little Rann of Kutch with restricted distribution present in this area. Due to its location and importance of plants the study was conducted in this area.

Land degradation may be defined as long-term loss of ecosystem function and productivity caused by disturbances from which land cannot recover unaided. It has also been used to estimate vegetation change, either as an index (Anyamba & Tucker, 2005; Olsson et al., 2005) or as one input to dynamic vegetation models (Nemani et al., 2003; Seaquist et al., 2003; Fensholt et al., 2006). Twenty-four per cent of the land area has been degrading over the last 25 years (Bai et al. 2008), directly affecting the livelihoods of 1.5 billion people; this is on top of the legacy of thousands of years of mismanagement in some long-settled areas.

Deterioration of the ecosystem can result in a major decline of species diversity, loss of vegetative cover, reduction of soil organic matter and soil moisture, increase in particulate generation, and significant changes in biogeochemical cycles. These variables and processes affect the interactive fluxes of energy and matter between the

atmosphere and the ecosystem. Vegetation directly influences climate in several ways including through albedo and surface roughness. Vegetation in dryland areas also reduces both fluvial and Aeolian erosion; increase in these erosion agents which can further result in a loss of ecosystem resources. Indirectly, vegetation contributes organic matter to the soil which affects albedo, adds insulation, and increases water holding capacity and infiltration (Robert C. Balling et al. 1998). Thus, changes in vegetative structure can affect the atmosphere at local and regional scales such that there exists a significant potential for positive feedback loops leading to the amplification of those changes. So taking land desertification/ degradation as a major problem this study was taken into account. The objective of the study was to analysis of different parameters of vegetation and soil as these are the chief indicators of land desertification/ degradation.

Study Area and Methodology

Study area

On the basis of pilot survey the study was taken out at Little Rann of Kutch (North part) near the Border of Wild Ass Sanctuary, which is located in Kutch district of Gujarat state of western India.

Field sampling

Study was carried out in 2013-14 by laying regular quadrats. On the basis of preliminary survey, eight study sites were demarcated based on topographic variation and named as site 1, 2, to 8. Eight sites of 1.8 km² were selected for the research, which is a saline desert. Total 128 quadrates for herbs (1x1 m²) and shrubs and trees (10x10 m²) and were organised for vegetation analysis. The size and the number of quadrates were determined by the species area curve (Misra, 1968) and the running mean method (Kershaw, 1973) respectively. Soil samples were randomly collected from four places at each site for three depths, namely, 0-15 cm, 15-30 cm and 30-45 cm. Result of each depth was made to average to obtain final result.

Vegetation analysis

The vegetation data were quantitatively analyzed for density, abundance and frequency following Curtis & McIntosh (1950). The relative values of frequency, density and dominance were determined following Phillips (1959). These values were summed to estimate IVI of individual species (Curtis 1959, Misra 1968). The ratio of abundance to frequency for different species was determined for eliciting the distribution patterns. This ratio indicates regular (<0.025), random (0.025 to 0.05) and contagious (>0.05) distributions (Curtis & Cottam 1956).

The species diversity index (DI) for different sites was determined by using Shannon-Wiener information function (\overline{H}) (Shannon & Wiener 1963).

$$\overline{H} = - \sum_{i=1}^s (N_i/N) \log_e (N_i/N)$$

Where, N_i is the importance value of each species, and N is the total importance value of all the species in a stand. Concentration of dominance (CD) was computed by Simpson's index (Simpson 1949).

$$CD = \sum_{i=1}^S (N_i/N)^2$$

Where, N_i and N are the same as for Shannon-Wiener information function. The calculations for the species diversity and concentration of dominance were made on tree individuals.

Soil analysis

In the present investigation following physical and chemical properties of soil were determined for all research sites.

Water holding capacity (WHC), Field capacity (FC) and Porosity (PO) was estimated following Misra (1968).

Bulk density: A pit of 10 cubic cm was dug and soil was taken out and oven dried to a constant weight. Soil weight in unit volume was computed to determine bulk density.

Particle density: It was measured by method given by USDA, 1968.

Soil texture: Texture was determined by Bouyoucos hydrometer method (Day 1965, Kunze 1965, Wilde et.al. 1979, Gee and Bauder 1986, and Anderson, and Ingram, eds. 1993).

pH: Soil pH was measured by a pH meter after preparing soil paste with distilled water (1:5 ratio).

Electric conductivity (EC): Electrical conductivity was measured by an E. C. meter.

Organic carbon (OC), Organic matter (OM) and Nitrogen (N): These were measured by following the method of Jackson, M.L.(1973).

Available Phosphorus (P): By following the method of Olsen, S.R., C.V. Cole, F.S. Watanabe and L.A. Dean (1954).

Potassium (K), Sodium (Na) and Calcium (Ca): These chemicals were measured by atomic absorbance spectrophotometers (AAS). These chemicals were measured by Lindsay, R.C. and Norvell, W.A. (1978).

RESULT

In order to assess the vegetation and soil the study area was divided into eight different sites and comparative analysis was done between diverse sites. The result of the study area was separately analyzed for both vegetation and soil, latter on the correlation was made between both. Variation in result was obtained among diverse sites of the study area.

Vegetation analysis

Total seventeen species were found of which ten species of grasses, five of herbs, one of shrub and climber. Ten species belongs to Poaceae and two belongs to Papilionaceae. Dominant species found were *Cressa cretica* Linn., and *Aeluropus lagopoides* (Linn.) Trin. ex Thw. at maximum sites. Species found at different sites (Table 1) varies, of eight sites 3 sites consists of 2 species only and maximum 5 species were found at different sites. Maximum density was found for *A. lagopoides* ($5.875 \text{ plants m}^{-2}$) at site 7 followed by *Cenchrus ciliaris* Linn. and *C. cretica* while least was found $0.063 \text{ plants m}^{-2}$ for some species as shown in table 1. 100% frequency was not obtained for any species. A/F ratio shows contagious distribution pattern. Concentration of dominance (CD) and diversity index (DI) were calculated on the basis of density, basal cover and IVI (Table 2). Result shows that maximum CD on the base of density, basal cover and IVI was obtained at site 8 (0.289, 0.265 and 0.250) while least obtained at site 1 and 2. DI on the base of density, basal cover and IVI was maximum obtained at different sites. DI on the base of density was maximum at site 6 (0.500), on the base of basal cover at site 7 (0.499) and on IVI base at site 8 (0.500) while minimum value obtained at different sites. A significant positive correlation for density (Fig. 1) was found between available phosphorus and organic carbon ($r = 0.959$ and 0.900) while negative correlation with sodium and clay ($r = -0.896$ and -0.543).

Soil analysis

At all sites from three different depths i.e. 0-15 cm, 15-30 and 30-45 were taken into account for analysis and the result was combined. Data presented in Table-3 show that soil pH varied from 8.712 to 9.683 with an average of 9.107. The minimum value of pH 8.712 and 8.830 was observed in sampling sites 5 and 8 and maximum value of pH was observed in sampling site 1 and 3. The electrical conductivity of the soil varied from 3.000 to 13.711 dSm^{-1} with an average of 9.503 dSm^{-1} . A significant positive correlation for EC (Table-5) was found between available potassium ($r = 0.971$) while negative correlation with sodium ($r = -0.515$).

The organic carbon (OC) content ranged from 0.163 to 0.876% with an average of 0.500%. Maximum OC content (0.851 and 0.876%) was found at site 7 and 8. Maximum and minimum value of organic matter also varies with organic carbon content. A significant positive correlation for organic carbon (Table-5) was found between available phosphorus and potassium ($r = 0.972$ and 0.527) while negative correlation with sodium ($r = -0.985$). The total nitrogen content ranged from 0.014 to 0.076 % with an average of 0.043%. The phosphorus content ranged from 13.258 to $32.270 \text{ kg ha}^{-1}$ with an average of $21.138 \text{ kg ha}^{-1}$. Sodium ranged from 25.128 to 49.713ppm with an average of 38.826ppm. Maximum Na (48.196, 42.539 and 49.713ppm) was found at site 3, 4 and 6. Calcium ranged from 157.172 to 178.218ppm with an average of 162.987ppm. Maximum Ca (178.218ppm) was found at site 5.

Data presented in Table-4 show that soil WHC varied from 11.031 to 38.894% with an average of 23.619%. The minimum value of WHC 11.108 and 11.031 % was observed in sampling sites 1 and 3 while maximum value of WHC was observed in sampling site 4, 5 and 8. The FC of the soil varied from 12.704 to 31.664% with an average of 20.549 %. Bulk density (BD) ranged from 1.858 to 2.418 gcc^{-1} with an average of 2.136 gcc^{-1} . Particle density (PD) ranged from 2.087 to 3.076 gcc^{-1} with an average of 2.616 gcc^{-1} . Porosity (PO) ranged from 13.776 to 44.819%

with an average of 23.376%. The mean value of sand, clay and silt were 25.739, 33.093 and 41.167%, which shows that soil texture is clay loam type.

DISCUSSION

Only seventeen species were found of which ten species of grasses, five of herbs, one of shrub and climber each. Ten species belongs to Poaceae and two belongs to Papilionaceae. Dominant species found were *Cressa cretica* Linn., and *Aeluropus lagopoides* (Linn.) Trin. ex Thw. at maximum sites. The OC content was low (<0.50%) in 50 % soil samples and remaining 25% were medium (0.50-0.75%) and remaining 25% (>0.75%) were high. The phosphorous content was low (<28 kg ha⁻¹) in 75 % soil samples and remaining 25% were medium (28-56 kg ha⁻¹). According to Tisdale et al. (1997), about 50% of phosphorous is found in organic form and decomposition of organic matter produces humus which forms complex with Al and Fe and protects the P fixation. A significant positive correlation ($r= 0.527$) was observed between organic carbon and potassium content (Table 5). Similar type of relationship was also reported by Chauhan (2001) and Singh and Mishra (2012). This might be due to creation of favourable soil environment with presence of organic matter. Significant positive correlation was also found between potassium and clay content. It might be due to the presence of most of the mica (biotite and muscovite) in finer fractions Singh and Mishra (2012).

A significant positive correlation for density (Fig. 1) was found with available phosphorous and organic carbon ($r = 0.959$ and 0.900) while negative correlation with sodium and clay ($r = -0.896$ and -0.543). When land contains high concentration of solutes and there is no opportunity to flush out accumulated salts to drainage system, salts can quickly reach levels that are injurious to salt sensitive species. High concentrations of salts have detrimental effects on plant growth (Garg & Gupta 1997, Mer et al. 2000) and excessive concentrations kill growing plants (Donahue et al. 1983). At earlier study it was found that temperature and rainfall affects the salinity and vegetation of the soil (Pilania and Panchal, 2013b) of an area. Due to less rainfall and high temperature the salinity of the soil increases. The main point behind less number of species and less density of plants is that excess salinity in soil water can decrease plant available water and cause plant stress. Maximum salinity during dry periods which lowers the osmotic potential of soil water (Hirpara et. al. 2005) may also cause loss of vegetation in the saline area. Due to high concentration of salinity there are different factors which do not allow vegetation to grow at the full strength such as salinity reduces nitrogen accumulation in plants and imbalance of the uptake of the essential nutrients (Feigin 1985, Garg et. al. 1993). Due to high concentration of sodium in soil, soil dispersion, clay platelet and aggregate swelling takes place. This soil dispersion causes clay particles to plug soil pores, resulting in reduce soil permeability. Soil dispersion hardens soil and blocks water infiltration, making it difficult for plants to establish and grow. Result of physical properties confirms with the result of earlier study which shows that maximum and minimum value of WHC and FC varies at different sites (Pilania and Panchal, 2013a). It was found that there is no particular pattern of WHC and FC during soil analysis it changes from place to place. WHC and FC was high which might be due to the high concentration of salt. Due to salinity and sodium the clay particles swells and decrease the pore space of the soil. Salinity can impair plant function, growth and developmental processes. Plants show great diversity for salt tolerance.

CONCLUSION

The study shows that complex of salts affect the vegetation of a saline desert. Organic carbon, phosphorous and porosity of the soil positively affect the vegetation and helps in the growth. High EC, pH and high percentage of clay affects vegetation negatively and are harmful for the growth of the vegetation.

ACKNOWLEDGMENT

Authors are gratefully acknowledging the financial and other logistic support from UGC, New Delhi and Saurashtra University, Rajkot, India.

REFERENCES

- Anderson, J.M., and J.S. Ingram, eds. 1993. Tropical Soil Biology and Fertility: A Handbook of Methods. 2nd ed. CAB International, Wallingford, UK. P. 93-94.

- Anyamba, A. & Tucker, C.J. 2005. Analysis of Sahelian vegetation dynamics using NOAA-AHVRN NDVI data from 1981–2003. *J. of Arid Environments*. **63**:596–614.
- Bai, Z.G., Dent, D. L., Olsson, L., and Schaefer, M.E. 2008. Proxy global assessment of land degradation. *Soil Use and Management*. **24**:223–234
- Balling, R.C, J. M. Klopatek, M. L. Hildebrandt, C. Moritz and C. J. Watts (1998). Impacts of land degradation on historical temperature records from the Sonoran desert, *Climatic Change* **40**: 669–681
- Chauhan J.S., 2001. Fertility status of soils of Birla Panchayat Samiti of Jodhpur district (Rajasthan). M.Sc. (Ag.) Thesis, MPUAT, Udaipur.
- Curtis, J. T. & G. Cottam. 1956. *Plant Ecology Workbook. Laboratory Field Reference Manual*. Burgess Publishing Co. Minnesota.
- Curtis, J. T. & R. P. McIntosh. 1950. The interrelations of certain analytic and synthetic phytosociological characters. *Ecology* **31**: 434-455.
- Curtis, J. T. 1959. *The Vegetation of Wisconsin, An Ordination of Plant Communities*. University Wisconsin Press, Madison, Wisconsin, USA.
- Day, P.R. 1965. Particle fractionation and particle-size analysis. Chap. 43 in *Methods of Soil Analysis, Part 1*. C.A. Black, ed. American Society of Agronomy, Madison. Pp. 545-567.
- Dornhue, R. L., R. W. Miller & J. C. Shickluna. 1983. *Soil : An Introduction to soils and plant Growth*. Prentice-Hall, London.
- Feigin, A. 1985. Fertilization management of crops irrigated with saline water. *Plant Soil* **89**: 285-299.
- Fensholt, R., Sandholt, I., Rasmussen, M.S., Stison, S. & Diouf, A. 2006. Evaluation of satellite-based primary production modelling in the semi-arid Sahel. *Remote Sensing of Environment*. **105**: 173– 188.
- Garg, B. K, Vyas, S. P., Kathju, S., Lahiri, A. N, Mali & Sharma PC. 1993. Salinity-fertility interaction on growth, mineral composition and nitrogen metabolism of Indian mustard. *Journal of Plant Nutrition* **16**: 1637-1650.
- Garg, B. K. & Gupta, I. C. 1997. *Saline Wastelands Environment and Plant Growth*. Jodhpur: Scientific Publishers.
- Gee, GW and JW Bauder. 1986. Particle-size analysis. p. 383-411. In A Klute (ed.) *Methods of Soil Analysis, Part 1. Physical and Mineralogical Methods*. Agronomy Monograph No. 9 (2ed). American Society of Agronomy/Soil Science Society of America, Madison, WI.
- Hirpara, K. D., Ramoliya, P. J., Patel, A. D. & Pandey, A. N. 2005. Effect of salinisation of soil on growth and macro- and micro-nutrient accumulation in seedlings of *Butea monosperma* (Fabaceae). *Anales de Biología* **27**: 3-14.
- Jackson, M. L. (1973). *Soil chemical Analysis*, prentice – Hall of India Private Limited, New Delhi. Pp. 38-56.
- Kershaw, K. A. (1973). *Quantitative and Dynamic Plant Ecology*, London: Edward Arnold Ltd.
- Kunze, G.W. 1965. Pretreatment for mineralogical analysis. Chap. 44 in *Methods of Soil Analysis, Part 1*. C.A. Black, ed. American Society of Agronomy, Madison. Pp. 568-577.
- Lindsay, R. C. and Norvell, W. A. (1978). Development of DTPA soil test for Zinc, Manganese and Copper. *Soil Sci. Soc. Am. J.* **42**:421-428.
- Mer RK, Prajith PK, Pandya DH & Pandey AN. 2000. Effect of salts on germination of seeds and growth of young plants of *Hordeum vulgare*, *Triticum aestivum*, *Cicer arietinum* and *Brassica juncea*. *Journal of Agronomy and Crop Science* **185**: 209-217.
- Misra, R. 1968. *Ecology workbook*. Oxford and IBH Publishing Company, Amsterdam.
- Nemani, R.R., Keeling, C.D., Hashimoto, H., Jolly, W.M., Piper, S.C., Tucker, C.J., Myneni, R.B. & Running, S.W. 2003. Climate-driven increases in global terrestrial net primary production from 1982 to 1999. *Science*. **300**:1560–1563.
- Olsson, L., Eklundh, L. & Ardo, J. 2005. A recent greening of the Sahel – trends, patterns and potential causes. *J. of Arid Environments*. **63**:556–566.
- Paliana, P. K. & N.S. Panchal. 2013a. Soil analysis at Little Rann of Kachchh in Maliya Tehsil of Morbi district of Saurashtra region of Gujarat state in India. *Life Sciences Leaflets* **12**:30-41
- Paliana, P. K. & N.S. Panchal. 2013b. Vegetation analysis at Little Rann of Kachchh in Maliya Tehsil of Gujarat state in India. *Journal of Basic and Applied Biology* **7**:6-10

- Seaquist, J.W., Olsson, L. & Ardo", J. 2003. A remote sensing-based primary production model from grassland biomes. *Ecological Modelling*. **169**:131–155.
- Shannon, C.E. & W. Wiener. 1963. *The Mathematical Theory of Communication*. Urbana University, Illinois Press.
- Simpson, E.H. 1949. Measurement of diversity. *Nature***163**: 688.
- Singh R.P. and S.K. Mishra 2012. Available macro nutrients (N, P, K and S) in the soils of Chiraigon block of district Varanasi (U.P.) in relation to soil characteristics. *Indian J.Sci.Res.* 3(1): 97-100
- Tisdale S. L., Nelson W. L., Beaton J. D. and Havlin J. L., 1997. *Soil Fertility and Fertilizers*. 5th edn. MacMillan Publishing Co., New Delhi: **144**, 198-201.
- USDA (1968). *Diagnosis and Improvement of Saline and Alkaline Soils*. Agril. Handbook no. 60, USDA, Oxford and IBH Publ. Co. Calcutta. Pp 156.
- Wilde, S.A., R.B. Corey, J.G. Iyer, and G.K. Voigt. 1979. *Soil and Plant Analysis for Tree Culture*. Oxford and IBH Publishing Co., New Delhi. Pp. 12-13.

Table 1: Vegetation Analysis at studied area

Sr. No.	Species	Density (plants m ⁻²)	Frequency (%)	Abundance (plants m ⁻²)	A/F	IVI
Site 1						
1	<i>Corchorus fascicularis</i> Lam.	0.063 ± 0.000	6.250	1.000	0.160	52.300
2	<i>Indigofera cordifolia</i> Heyne ex Roth	0.188 ± 0.000	18.750	1.000	0.053	60.125
3	<i>Chloris barbata</i> Sw.	0.500 ± 0.354	12.500	4.000	0.320	67.186
4	<i>Chloris virgata</i> Sw.	0.313 ± 0.289	18.750	1.667	0.089	89.108
5	<i>Digitaria ciliaris</i> (Retz.) Koel.	0.188 ± 0.000	6.250	3.000	0.480	31.281
Site 2						
1	<i>Cressa cretica</i> Linn.	1.438 ± 0.718	43.750	3.286	0.075	106.499
2	<i>Suaeda fruticosa</i> (Linn.) Forsk.	0.375 ± 0.250	18.750	2.000	0.107	65.245
3	<i>Aeluropus lagopoides</i> (Linn.) Trin. ex Thw.	0.750 ± 0.000	6.250	12.000	1.920	50.684
4	<i>Eragrostis ciliaris</i> (Linn.) R. Br.	0.313 ± 0.000	6.250	5.000	0.800	24.545
5	<i>Eragrostis uniolooides</i> (Retz.) Nees ex. Steud.	0.438 ± 0.000	6.250	7.000	1.120	53.026
Site 3						
1	<i>Digera muricata</i> (Linn.) Mart.	0.125 ± 0.000	6.250	2.000	0.320	57.879
2	<i>Crotalaria medicaginea</i> Lam.	0.313 ± 0.000	6.250	5.000	0.800	89.646
3	<i>Mukia maderaspatana</i> (Linn.) M. Roem.	0.063 ± 0.000	6.250	1.000	0.160	99.834
4	<i>Cynodon dactylon</i> (Linn.) Pers.	0.063 ± 0.000	6.250	1.000	0.160	52.640
Site 4						
1	<i>Aristida adscensionis</i> Linn.	0.750 ± 0.000	6.250	12.000	1.920	97.580
2	<i>Echinochloa colona</i> (Linn.) Link	0.563 ± 0.884	12.500	4.500	0.360	115.483
3	<i>Eragrostis uniolooides</i> (Retz.) Nees ex. Steud.	0.063 ± 0.000	6.250	1.000	0.160	86.938
Site 5						
1	<i>Cenchrus ciliaris</i> Linn.	0.063 ± 0.000	6.250	1.000	0.160	111.582
2	<i>Eragrostis ciliaris</i> (Linn.) R. Br.	0.188 ± 0.000	6.250	3.000	0.480	48.156

Sr. No.	Species	Density (plants m ⁻²)	Frequency (%)	Abundance (plants m ⁻²)	A/F	IVI
3	<i>Cressa cretica</i> Linn.	1.188 ± 0.884	12.500	9.500	0.760	140.262
Site 6						
1	<i>Cressa cretica</i> Linn.	0.188 ± 0.177	12.500	1.500	0.120	138.770
2	<i>Aeluropus lagopoides</i> (Linn.) Trin. ex Thw.	0.188 ± 0.177	12.500	1.500	0.120	161.230
Site 7						
1	<i>Aeluropus lagopoides</i> (Linn.) Trin. ex Thw.	5.875 ± 1.015	68.750	8.545	0.124	160.402
2	<i>Cressa cretica</i> Linn.	3.875 ± 1.296	75.000	5.167	0.069	139.598
Site 8						
1	<i>Cenchrus ciliaris</i> Linn.	5.313 ± 2.364	50.000	10.625	0.213	154.487
2	<i>Cressa cretica</i> Linn.	2.313 ± 1.476	56.250	4.111	0.073	145.513

Table 2: Concentration of Dominance and Diversity Indexes at studied area

Sites	CD			DI		
	Density	Abundance	IVI	Density	Abundance	IVI
1	0.054 ± 0.028	0.057 ± 0.029	0.044 ± 0.013	0.413 ± 0.055	0.399 ± 0.060	0.450 ± 0.030
2	0.056 ± 0.034	0.051 ± 0.021	0.048 ± 0.021	0.414 ± 0.039	0.423 ± 0.052	0.436 ± 0.039
3	0.096 ± 0.072	0.113 ± 0.098	0.067 ± 0.020	0.414 ± 0.036	0.376 ± 0.028	0.487 ± 0.022
4	0.156 ± 0.085	0.141 ± 0.095	0.113 ± 0.019	0.402 ± 0.101	0.468 ± 0.015	0.525 ± 0.004
5	0.234 ± 0.224	0.231 ± 0.223	0.128 ± 0.056	0.269 ± 0.058	0.283 ± 0.030	0.489 ± 0.033
6	0.250 ± 0.000	0.263 ± 0.092	0.251 ± 0.031	0.500 ± 0.000	0.482 ± 0.039	0.498 ± 0.013
7	0.261 ± 0.084	0.251 ± 0.019	0.251 ± 0.028	0.485 ± 0.036	0.499 ± 0.008	0.498 ± 0.013
8	0.289 ± 0.161	0.265 ± 0.100	0.250 ± 0.012	0.443 ± 0.065	0.478 ± 0.043	0.500 ± 0.005

Table 3: Chemical Properties and nutrients of soil at studied area

Sites	pH	EC (dSm ⁻¹)	OC (%)	OM (%)	N (%)	P (kg ha ⁻¹)	K (ppm)	Na (ppm)	Ca (ppm)
1	9.372 ± 0.033	3.000 ± 0.000	0.286 ± 0.024	0.493 ± 0.041	0.025 ± 0.002	18.011 ± 0.433	425.461 ± 23.472	47.341 ± 0.161	157.298 ± 5.025
2	9.683 ± 0.088	10.344 ± 1.531	0.670 ± 0.013	1.155 ± 0.023	0.058 ± 0.001	23.514 ± 0.250	867.904 ± 3.425	30.960 ± 0.241	157.172 ± 5.706
3	9.366 ± 0.025	3.000 ± 0.000	0.250 ± 0.017	0.431 ± 0.029	0.022 ± 0.001	15.009 ± 0.433	382.458 ± 4.983	48.196 ± 0.156	157.433 ± 1.927
4	8.864 ± 0.031	11.533 ± 0.721	0.355 ± 0.019	0.612 ± 0.033	0.031 ± 0.002	17.010 ± 0.662	882.479 ± 3.596	42.539 ± 0.288	168.160 ± 2.528
5	8.712 ± 0.047	13.711 ± 1.235	0.550 ± 0.010	0.949 ± 0.017	0.047 ± 0.001	21.013 ± 0.433	884.260 ± 2.731	38.139 ± 0.366	178.218 ± 5.295
6	8.996 ± 0.070	11.611 ± 0.513	0.163 ± 0.019	0.281 ± 0.032	0.014 ± 0.002	13.258 ± 0.662	888.453 ± 4.142	49.713 ± 0.719	163.287 ± 2.744
7	9.032 ± 0.071	12.133 ± 0.744	0.851 ± 0.044	1.467 ± 0.077	0.073 ± 0.004	32.270 ± 0.867	899.909 ± 2.902	25.128 ± 0.193	160.536 ± 1.882
8	8.830 ± 0.033	10.689 ± 0.335	0.876 ± 0.036	1.511 ± 0.061	0.076 ± 0.003	29.018 ± 0.250	893.481 ± 4.433	28.588 ± 0.236	161.792 ± 4.110
Range	8.712 to 9.683	3.000 to 13.711	0.163 to 0.876	0.281 to 1.511	0.014 to 0.076	13.258 to 32.270	382.458 to 899.909	25.128 to 49.713	157.172 to 178.218
Mean	9.107	9.503	0.500	0.862	0.043	21.138	765.551	38.826	162.987

Table 4: Physical Properties of soil at studied area

Sites	WHC (%)	FC (%)	Sand (%)	Clay (%)	Silt (%)	BD (gcc ⁻¹)	PD (gcc ⁻¹)	PO (%)
1	11.108 ± 0.586	12.704 ± 0.573	25.108 ± 0.962	33.125 ± 1.663	41.767 ± 2.430	2.418 ± 0.046	3.001 ± 0.254	15.114 ± 6.814
2	12.823 ± 0.509	14.856 ± 1.524	24.721 ± 1.265	37.253 ± 1.338	38.026 ± 0.074	1.858 ± 0.059	2.570 ± 0.328	34.470 ± 5.872
3	11.031 ± 0.323	14.560 ± 0.895	26.484 ± 1.209	31.134 ± 1.386	42.381 ± 0.551	2.236 ± 0.058	3.076 ± 0.352	20.289 ± 8.344
4	36.932 ± 2.101	24.403 ± 1.075	25.197 ± 0.654	33.293 ± 1.768	41.510 ± 1.786	2.113 ± 0.072	2.280 ± 0.094	19.882 ± 4.303
5	38.894 ± 1.198	23.874 ± 0.627	27.572 ± 0.625	29.895 ± 0.020	42.533 ± 0.643	2.076 ± 0.010	2.087 ± 0.103	13.776 ± 2.247
6	16.367 ± 0.363	20.400 ± 0.788	24.881 ± 0.593	31.244 ± 1.372	43.875 ± 1.945	2.186 ± 0.030	2.393 ± 0.124	16.446 ± 2.732
7	23.257 ± 3.971	31.664 ± 5.713	25.977 ± 1.156	32.669 ± 1.333	41.355 ± 2.405	2.128 ± 0.030	2.798 ± 0.500	44.819 ± 5.967
8	38.541 ± 0.911	21.935 ± 1.659	25.974 ± 0.003	36.133 ± 4.002	37.893 ± 4.001	2.077 ± 0.008	2.721 ± 0.124	22.213 ± 4.076
Range	11.031 to 38.894	12.704 to 31.664	24.721 to 27.572	29.895 to 37.253	37.893 to 43.875	1.858 to 2.418	2.087 to 3.076	13.776 to 44.819
Mean	23.619	20.549	25.739	33.093	41.167	2.136	2.616	23.376

Table 5: Correlation between soil characteristics and chemical parameters of soil at studied area

Soil Properties	N (%)	P (kg ha ⁻¹)	K (ppm)	Na (ppm)
pH	-0.156	-0.135	-0.507	0.096
EC (dSm ⁻¹)	0.465	0.386	0.971	-0.515
OC (%)	1.000	0.972	0.527	-0.985
Clay (%)	0.536	0.465	0.232	-0.551

Fig 1: Correlation between soil parameters and Density of vegetation at studied area