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ORIGINAL ARTICLE **OPEN ACCESS**

Physicochemical Analysis of Coastal Soil on southwest Coast of Junagadh District, Gujarat

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ABSTRACT
The Junagadh district coastal zone is bounded to the southwest by the Arabian sea and is ecologically important to showing the presence of corals, halophytic species, mangroves, and mudflats. There are different types of habitats observed on the Junagadh district coast viz. sandy, rocky, and marshy region. In saline habitat, salt-tolerant plant species were conserved, mainly, Prosopis juliflora, Casuarina equisitifolia, and Salvadora persica. Plantation of coastal vegetation is done to conserve the soil of the coast.A physicochemical study of soil is based on various parameters like soil pH, electrical conductivity (EC), organic carbon (OC), sodium (Na^+), potassium (K^+), chloride (Cl^-) calcium (Ca^{2+}), and magnesium (Mg^{2+}). Soil samples were collected from a total of 12 locations of the Junagadh district coastal zone during the winter, monsoon, and summer seasons. From this study, it has been revealed that there is an excessive amount of salt concentration sodium (Na^+) and chloride (Cl^-) was present in soil. It has been analysed edaphic conditions including variation in electrical conductivity, pH and mineral composition in soils during winter, summer and monsoon seasons.
Keywords: halophytic species, salt-tolerant, phytochemical, edaphic condition, mineral composition

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INTRODUCTION

In India, the coastal region covers a long strip along the east coast and west coast. Approximately 45 km longest coastline is there in Junagadh district. Salinity is a common phenomenon of arid and semi-arid regions and information regarding salinization toward the natural processes is leading the understanding of any habitat based on their salt status. Whenever accumulated and deposited salt were placed in any habitat, then the formation is encountered by saline habitat. Thus, environments are diverse and widespread and include land within the tidal zone, salt marshes, coastal habitats, inland salt lakes, and saline deserts [5].Major threats of the globally endangered saline habitats are thought to be improvement and ploughing, as well as an abandonment of traditional management and ruralization.

The presence of a certain amount of salt in the soil creates more favourable conditions for the growth of the halophytes. Soil pH and elevation are the most important factors influencing the vegetation composition in salt-affected communities [15]. As the main problem of agricultural soil loss, the problem of soil alkalinity is accepted worldwide. Regional salinity problems are increasing in agriculture due to naturally saline soils, low rainfall, poor waste management, high evaporation, and brackish water irrigation [8]. Numerous investigations have shown that Na^+, $C1^-$ and occasionally SO_4^+ which provide a suitable water potential gradient to maintain soil water absorption are common characteristics of alkali-affected plants [3, 11].

Approximately 2% of terrestrial plant species are salt-tolerant [7]. The vegetation cover of the salt marshes is considered as highly specialized plant growth, they have great ability to adapt salt tolerance component. The vegetation of halophytic species is influenced by several stress factors such as ion toxicity, deficiency of nutrients, suboptimal soil pH, high osmotic pressure, and unfavorable soil structure [6]. Halophytic vegetation is extremely diverse and complex, and the main factor for its development are saline condition and moisture. Major threats of the globally endangered saline habitats are thought to be improvement and ploughing, as well as an abandonment of traditional management and ruralization. Soil may be defined as the naturally deposited unconsolidated material which covers the earth's surface, whose chemical, physical, and biological properties are capable of supporting plant growth [12]. The climate and other factors largely affect soil formation [1]. The most important physical property in the soil is pH, it has a great effect on the concentration of solute and absorption of soil [2, 10]. In this saline environment plant mechanized to resist saline habitat, like salt-avoiding, salt salt-tolerant etc [13].

MATERIAL AND METHODS

Study area

A total of 12 locations included in Mangrol and Maliya Taluka of the Junagadh district region (21°13'N to 21° 00'N and 69°59' E to 70° 13' E) were selected as the study area for this investigation. Nine villages were surveyed of Mangrol taluka namely, Antroli, Diwasa, Sangavada, Shil, Lodge, Rahij, Maktupur, Mangrol, and Khodada, whereas three villages were surveyed of Maliya taluka namely, Khambhadiya, Jujarpur, and Chorvad (Fig. 1).

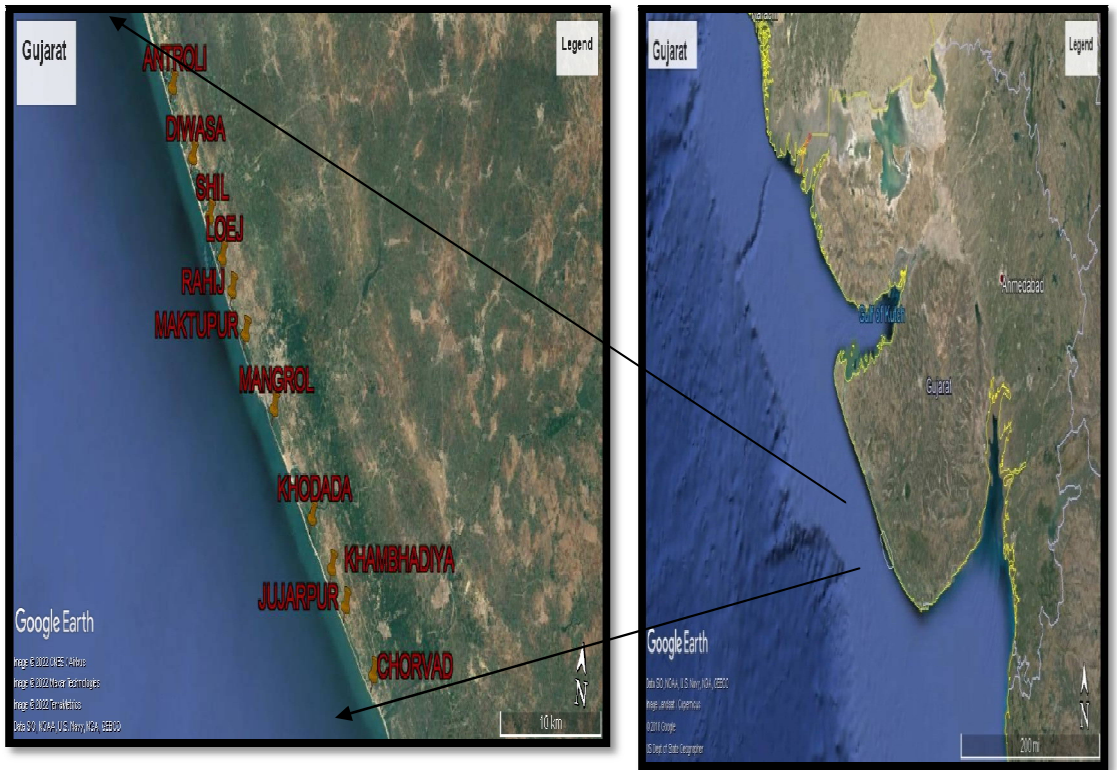
Collection and preparation of soil sample

Soil samples were collected around 1kg of 0-15 cm deep depth in triplicate no. of each twin belt transect and collected in ziplocked polythene bags. The chemical analysis was conducted on air-dry soil that passed through a 2-mm sieve. 100 g of soil sample was taken in a conical flask and add 200 ml deionized water and prepare 1: 2 soil: water suspension. This suspension shakes well and keep overnight in a shaker. The solution was filtered and then makeup into 250 ml for further analysis.

Physico-chemical characteristics

A pH of 1:2 extracts was measured in pH meter; electrical conductivity was measured in EC meter and Na^+ and K^+were measured in the flame photometer. Calcium (Ca^{2+}) and Magnesium (Mg^{2+}) were estimated by EDTA (ethylene diamine tetraacetic acid) method [4]. Chloride (Cl^-) was estimated by the argentometric method [9]. Organic carbon was estimated by Walkley and Black titration method [14]. Sodium absorption ratio (SAR) was determined by the following formula: $SAR= Na^+/[(Ca^{2+}+Mg^{2+})/2]^{1/2}$.

Fig. 1: Map showing study area (Source: Google earth).



RESULTS AND DISCUSSION

Result of Physico-chemical analysis of 12 locations of sandy, marshy and rocky habitats of Junagadh district. Soil samples were collected in winter, summer, and monsoon, these samples were considered for seasonal variation. Values indicated the mean value of 3 twin belt transects sample in individual habitat.

Results of physicochemical characteristics of soil samples during the winter season showed (Table 1) that electrical conductivity (EC) and pH range between 3.52 to 6.71 (mS/cm) and 7.9 to 9.21. SAR varied from 3.01 to 6.58. Na^+ and Cl^- ranging between 3.8 to 7.82 (meq. g^{-100}) and 4.31 to 11.91 (meq. g^{-100}). Mg^{2+} content 1.84 to 2.91 (meq. g^{-100}) was greater than that of Ca^{2+} content 0.82 to 1.43 (meq. g^{-100}). K^+ concentration was noticed in low amounts of ranging from 0.15 to 0.31 (meq. g^{-100}). Organic carbon was found between 0.08 to 0.51%. Na^+ (7.82 meq. g^{-100}) and Cl^- (11.91 meq. g^{-100}) content, as well as salinity of 6.71 (mS/cm), was higher in the Diwasa location, which is marshy habitat (Table 1).

The salinity of the monsoon season was noted in a range of 2.89 to 5.31 (mS/cm), whereas pH and SAR fluctuated between 7.83 to 8.24 and 3.18 to 6.1 (Table 2). The ratio of Na^+ and Cl^- concentration was approximately the same, which was ranging between 3.42 to 6.25 (meq. g^{-100})and 3.96 to 6.91 (meq. g^{-100}).

Mg^{2+} concentration 0.97 to 2.68 (meq. g^{-100}), which was greater than that of Ca^{2+} concentration 0.34 to 1.34 (meq. g^{-100}). K^{+} concentration was noticed in low amounts of ranging from 0.12 to 0.23 (meq. g^{-100}). Organic carbon was noticed to vary from 0.05 to 0.23%. The concentration of Na^{+} 6.24 (meq. g^{-100}) and Cl^{-} 6.91 (meq. g^{-100}) was higher in the Diwasa location, which is marshy habitat and conductivity of 5.31 (mS/cm) was higher in Sangavada village, which is sandy habitat.

Table 1: Physico-chemical characteristics of selected 12 locations during winter season.

Location	pH	EC (mS/cm)	SAR	Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	Cl^{-}	TOC (%)
				(meq. g^{-100})					
L1	7.93	4.62	6.58	0.82	1.48	7.06	0.24	8.02	0.12
L2	9.21	6.71	5.43	1.24	2.91	7.82	0.21	11.91	0.24
L3	8.95	6.32	4.72	1.43	2.26	6.41	0.26	7.26	0.09
L4	8.23	4.01	3.01	1.06	2.12	3.8	0.18	5.03	0.15
L5	8.51	5.18	3.42	0.92	1.84	4.02	0.16	4.31	0.21
L6	8.73	5.24	3.47	1.1	2.19	4.45	0.15	4.63	0.24
L7	7.9	4.11	4.05	1.06	1.99	5	0.18	6.32	0.51
L8	8.13	3.52	4.13	1.03	2.01	5.1	0.16	5.74	0.12
L9	8.21	5.75	3.19	1.17	2.34	4.23	0.17	5.83	0.24
L10	8.38	5.01	4.52	1.12	2.28	5.89	0.31	7.32	0.15
L11	8.37	4.04	4.76	1.01	2.18	6.01	0.26	6.95	0.08
L12	8.11	4.45	4.74	0.95	2.07	5.79	0.28	7.63	0.42

(L1=Antroli; L2=Diwasa; L3=Sangavada; L4=Shil; L5=Loej; L6=Rahij; L7=Maktupure: L8=Mangrol; L9=Khodada; L10=Khambhadiya; L11=Jujarpur and L12=Chorvad)

Table 2: physico-chemical characteristics of selected 12 locations during monsoon season.

Location	pH	EC (mS/cm)	SAR	Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	Cl^{-}	TOC (%)
				(meq. g^{-100})					
L1	7.91	4.21	5.72	0.34	1.23	5.06	0.21	6.23	0.09
L2	8.13	5.01	4.92	0.79	2.43	6.24	0.23	6.91	0.13
L3	8.27	5.31	5.51	0.68	1.54	5.81	0.17	6.21	0.05
L4	8.12	4.01	3.51	0.67	1.23	3.42	0.18	3.96	0.16
L5	8.1	4.25	3.89	0.63	1.39	3.91	0.15	4.26	0.23
L6	8.24	3.92	4.04	0.41	1.78	4.23	0.17	5.16	0.21
L7	8.02	4.23	4.1	0.81	2.01	4.87	0.12	4.99	0.16
L8	8.09	4.09	3.54	1.34	2.68	5.03	0.15	5.23	0.22
L9	8.14	2.89	3.18	1.01	2.32	4.11	0.15	5.42	0.16
L10	8.23	4.97	6.1	0.42	1.32	5.69	0.23	6.23	0.18
L11	8.21	4.23	5.65	0.41	1.69	5.79	0.21	6.63	0.16
L12	7.83	3.31	5.99	0.61	0.97	5.32	0.22	6.82	0.08

Table 3: physicochemical characteristics of selected 12 locations during summer season.

Location	pH	EC (mS/cm)	SAR	Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	Cl^{-}	TOC (%)
				(meq. g^{-100})					
L1	7.93	3.62	7.13	0.82	1.48	7.65	0.24	9.23	0.22
L2	9.22	4.71	4.73	1.24	2.91	6.82	0.21	8.01	0.14
L3	8.95	4.32	4.72	1.43	2.26	6.41	0.26	7.26	0.11
L4	8.23	4.01	4.67	1.06	2.12	5.89	0.18	5.03	0.13
L5	8.51	5.18	7.76	0.92	1.84	9.12	0.16	14.26	0.11
L6	8.73	5.24	3.88	2.1	2.19	5.69	0.11	7.02	0.23
L7	7.9	4.11	4.05	1.06	1.99	5	0.18	6.32	0.31
L8	8.13	4.52	4.13	1.03	2.01	5.1	0.17	5.74	0.02
L9	8.21	5.75	4.31	1.17	2.34	5.71	0.16	5.83	0.29
L10	8.38	3.01	4.53	1.12	2.28	5.89	0.37	7.32	0.13
L11	8.37	4.04	4.76	1.01	2.18	6.01	0.26	8.32	0.18
L12	8.11	3.45	4.71	0.95	2.07	5.79	0.28	7.63	0.32

Physicochemical characteristics of soil samples during the summer season showed (Table 3) that electrical conductivity was noted in the range from 3.01 to 5.24 (mS/cm) and pH range between 7.9 to 9.22. SAR varied from 3.88 to 7.76. Na^{+} and Cl^{-} ranging between 5 to 9.12 (meq. g^{-100})and 5.74 to 14.26 (meq. g^{-100}). Mg^{2+} content 1.48 to 2.91 (meq. g^{-100}) was greater than that of Ca^{2+} 0.82 to 2.1 (meq. g^{-100}). K^{+} concentration was noticed in low amounts of ranging from 0.01 to 0.37 (meq. g^{-100}). Organic carbon was found between 0.02 to 0.31%. Na^{+} content 9.12 (meq. g^{-100}) and Cl^{-} content 14.26 (meq. g^{-100}) were higher

in Loej village and salinity 5.24 (mS/cm) was higher in Rahij village, which both locations are rocky habitats. These results preliminary indicated a high value of salinity (EC), Na^+, and Cl^- during the summer season. The concentration of mineral ions in summer was greater than in monsoon and winter seasons.

CONCLUSION

This study concluded that investigates edaphic conditions in different habitats of the coastal region of Junagadh district, and it verifies the impact of soil salinity on the coastal plant diversity. This study outcome reveals an inverse relationship between soil condition and biodiversity. Throughout the different locations of Junagadh district coastal zone mainly representing the exotic invasive species *Prosopis juliflora* and also conserved *Casuarina equisitifolia* and *Salvadora persica*. The salt tolerance species, *Sericostomapauciflorum, Cressacretica, Lotus garcinia, Cyprus conglomerates Halopyrummucronatum, Taraxacum mongolicum*, and other plant species were also recorded in saline habitats of the Junagadh district. Analysis total of 12 locations soil samples of coastal region collected during 3 seasons from the selected locations indicated noticeable moderate to high concentrations of Na^+, Cl^- and Ca^{2+} followed by that Mg^{2+} and K^+ were observed in habitats. Average salinity and amounts of mineral ions in summer season were remarkably high to comparison with winter and monsoon season. Remarkable differences of seasonal variation in edaphic conditions were observed in different habitats of Junagadh district (Gujarat).

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