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MAJOR NUTRIENTS STATUS IN SOIL AND ASSESSMENT OF QUALITY OF IRRIGATION WATER OF KACHCHH DISTRICT OF GUJARAT, INDIA

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ABSTRACT

A study was undertaken to assess the status of available major nutrients in soils and quality of irrigation water of Kachchh district of Gujarat by Regional Research Station, S. D. Agricultural University, Bhachau, Kachchh during 2014-2018. About Forty representative surface (0-15 cm) soil samples were collected from farmer's field of each taluka. The soil samples were analyzed for ph, EC, organic carbon, available N, P_2O_5, and K_2O. Soils of Kachchh district are mildly alkaline to moderately alkaline in reaction ($ph_{2.5}$ 8.14) with low soluble salt content (EC 0.57 ds/m).The organic carbon status of soils of Kachchh district was low (0.35 %). The available N, P_2O_5 and K_2O content in these soils ranged from 62.72 to 392.00, 16.81 to 116.58 and 107.52 to 954.24 kg/ha with a due, soils of Kachchh district were very low in available nitrogen, marginal in available phosphorus and high in available potassium status. Highly significant and positive correlation was observed between organic carbon with available nitrogen (r = 0.842**). Available P_2O_5 show mean value of 193.93, 41.85 and 330.86 kg/ha, respectively. On the basis of nutrient index had negative correlation with ph (r = -0.066) and EC (r = -0.011). Available N (r = 0.178**) and O.C. (r = 0.193**) have highly significantly and positively correlated with ph.

Assessment of quality of irrigation water there were total 369 water samples were collected from 10 different talukas of Kachchh district. RSC of most of water sample was observed safe (88.89%), only 5.15 and 5.96 % sample are categorized under marginal and unsafe. RSC level Mundra > Mandvi > Bhuj observed. Chloride concentration of Kutch district water samples whose observed Mandvi > Gandhidham > Mundra > Bhachau > Rapar. Soluble salt was observed in order Mundra > Rapar > Mandvi > Gandhidham > Abdasa. In case of sodium hazard Mundra > Mandvi > Abdasa.

Keywords **:** pH, EC, Available N, P_2O_5, and K_2O, Quality of irrigation water

Introduction

Soil, a non-renewable natural resource essential for all forms of life is a major concern for safety. It has been nurturing every living form directly or indirectly since, the evolution of life forms on planet earth. The soil is one such natural resource that requires constant attention for maintaining its fertility and productivity. Proper management of soil fertility demands careful identification of constraints of current nutrient deficiencies and build up with monitoring changes in soil fertility to ensure continued high productivity in the future and it also act as a one or the key component to determine the state of the soil health.

Quality of irrigation water plays a vital role in crop production. Under the application of good quality water we have choice to grow any crop and their varieties without any limitations. Under the application of poor irrigation water we have to take care because it not only decreases the crop production but also spoil the soil health i.e. physical, chemical and biological properties of soil. Accumulation of excess salts in soils and consequent development of salinity and sodicity in soils is common in arid and semi arid regions. Groundwater irrigation deteriorates the soil quality when it is rich in soluble salts and residual sodium carbonate (RSC). Irrigation with such waters lead to secondary salinization, deterioration in soil properties, restricted availability of major and micronutrients and reduction in crop yields (Gupta *et al*., 2000; Joshi and Bohra, 2009). Due to presence of salt affected soils and poor quality water of Kachchh district it is necessary to determine the interfering elements responsible for reduction in crop growth, yield and quality. So present study was conducted in which we collected the water samples from various villages of entire talukas of Kachchh and analyzed them.

In order to assess the quality of irrigation water and their suitability and unsuitability to the crops 369 water samples from the wells and tube wells of various villages of all the ten talukas of Kachchh district (Gujarat) were collected. After collection and labeling of samples all the

samples were filtered using filter. The water samples were analyzed for EC, pH, Ca^{++}, Mg^{++}, Na^{+}, CO_3^{-}, HCO_3^{-}, Cl^{-} and F^{-} by adopting standard procedures and further the Sodium Adsorption Ratio (SAR) and Residual Sodium Carbonate (RSC) values of the samples were calculated and interpreted based on their suitability and unsuitability to the crops. Similar kind of work has been reported by Kumar and Sharma (2010).

Materials and Methods

The present investigation was carried out to assess macronutrients status of the soils of Kachchh district. Kachchh is a largest district (45,652 km^2) of Gujarat state. It lies at 22°44'11" to 24°41'25" North Latitude and 68° 09'46" to 71°54'47" East Longitude. It's an arid district of Gujarat covering 73 per cent of the total geographical area of the arid region of this state. Soils of Kachchh are low water holding capacity, poor fertility, erosive, low to medium nutrients status, undulating topography and soil salinity/alkalinity. Similar to the inland talukas, annual rainfall in the seven coastal talukas of Kachchh is also poor, ranging from 250-350 mm and is often irregular. Mean rainfall (1932 to 2001) was highest at Mundra (407 mm) while Mandvi and Abadasa talukas recorded a mean rainfall of 387 and 378 mm respectively, for this period. Winter and summer temperature range from 7 to 48°C with an average humidity of 60%/year which is increase to 80% during south-west monsoon and decrease to 50% during November- December. Average wind speed is 4.65 km/hr/year with a maximum wind speed of 10.61 km/hr during June. The phenomenon of drought is common with 2 drought year in a cycle of 5 years. As a characteristic of arid zone, annual temperature fluctuation in the district is extreme, ranging from 4°C to 48.5^{0}C. To assess the available nitrogen, phosphorus and potassium in soils of Kachchh district, total 400 representative surface soil samples were collected from farmer's fields of each taluka of Kachchh district during 2016. One representative surface sample was collected from field up to a depth of 0 to 20 cm by multistage stratified random sampling method (Singh *et al*., 1982). All the composite soil samples were air-dried, ground and passed through 2 mm sieve for chemical analysis. All the samples were stored in the polythene bags for further analysis. Soil pH and electrical conductivity (EC) were determined by potentiometery and direct reading conductivity meter using 1:2.5 soil water suspensions (Jackson, 1973). The composite soil samples were analyzed for available nitrogen (Subbiah and Asija, 1956), available P_2O_5 Olsen *et al.* (1954), neutral ammonium acetate extractable K_2O (Jackson, 1973), organic carbon (Walkley and Black, 1934). The relationship between various soil properties and macro-nutrients distribution were established by using simple correlation co-efficient.

Total 369 water samples were collected from different 10 talukas of Kachchh district of Gujarat. Before monsoon collected filtered and stored in plastic bottle standard method of analysis of different constitute are used and analyzed the sample.

The pH of water sample was determined by using glass electrode pH meter and electrical conductivity was determined by using EC meter (Jackson, 1973), sodium (K^+) content in water samples were determined by using flame photometer (Jackson, 1973), carbonate, chloride and sulphate (CO_3^{-}, Cl^{-} and SO_4^{-}) were determined by the Mohrs titration method (Richards, 1954).

Results and Discussion

The results obtained from the present investigation as well as relevant discussion have been summarized below:

Nutrients status of soil

Forty surface soils (0 to 20 cm) of Kachchh district were analyzed. The results of soil pH, and EC represented in Table 1 and 2, respectively. In general, the soils of this district are moderately alkaline to very strong alkaline in reaction. The pH values of the soils for the entire district were ranging from 6.90 to 9.60 with a mean value of 8.14. The lowest mean pH value of 7.78 was recorded in a soil of Lakhpat taluka and the highest mean value of 8.58 was recorded in the soil of Mundra taluka. The relative high pH in the soils might be due to presence of high degree of base saturation. Similar results were also obtained for soils of Amritsar district of Punjab (Sharma *et al.,* 2008).

Conductivity, as a measure of current carrying capacity, gives a clear idea of the soluble salts present in the soil. It plays a major role in the salinity of soils. Lesser the EC value, low will be the salinity value of soil and vice versa. Overall, EC in the soils of Kachchh district varied widely ranged from 0.07 to 6.05 with a mean value of 0.57 dS/m. The lowest 0.07 dS/m EC value was recorded in the soil sample collected from Bhachau taluka, whereas highest value of 6.05 dS/m was recorded in Lakhpat taluka. The low EC of soil might be due to proper management of soil and thereby leaching of salt take place from surface to sub-subsurface soil. The results are strongly supported by the findings of Meena *et al.* (2006) in soils of Tonk district of Rajasthan. The soluble salts concentration above 4 dS/m in soil moisture inhibits the seed germination and growth of most commercial crops, which adversely affects the biomass production and economic yield.

The soil organic carbon content surface soil ranged from 0.08 to 0.99 per cent with a mean value of 0.35 per cent. Such low values for organic carbon status of soils are expected because of the rapid decomposition and mineralization of organic matter in semi-arid and particularly negligible replacement of organic matter. Polara *et al.* (2006) also reported similar results for salt affected soils of North-West agro climatic zone of Gujarat. Available N (r = 0.178**) and O.C. (r = 0.193**) have highly significantly and positively correlated with pH. Similar result obtained for soils of Senapati district of Manipur (Athokpam *et al.,* 2013)

The nutrient index value for available nitrogen was ranged from 1.03 to 1.35 with mean value 1.16 which indicated that very low status of available nitrogen in soils of Kachchh district. Available N status for the targeted district was low, medium and it range from 62.72 to 392.00 kg/ha with a mean value of 193.93 kg/ha. The highest mean value of available nitrogen was found in Gandhidham taluka (248.14 kg/ha) followed by Anjar (225.01 kg/ha) and Mundra taluka (220.31 kg/ha). The lowest mean value of available nitrogen was found in a soils of Bhachau taluka (151.70 kg/ha). Such lower values for available N might be due to lower content of organic carbon and poor addition of organic matter as well as less use of organic manures in the semi-arid area. The results are strongly supported by the findings of Polara and Kabariya (2006) in soil from Amreli district of Gujarat. The data of

correlation values indicated highly significant positive relations between organic carbon with available nitrogen (r = 0.842**). Similar result obtained for soils of Tonk district of Rajasthan (Meena *et al.*, 2006).

The nutrient index value for available phosphorus was ranged from 1.45 to 2.03 with mean value 1.67 which indicate available P_2O_5 was marginal in Kachchh district. The available P_2O_5 content of soil samples of Kachchh district varied widely from 16.81 to 116.58 kg/ha with mean value of 41.85 kg/ha. The overall mean value of available phosphorus (41.85 kg/ha) indicated that the soils of Kachchh district was medium in available phosphorus status. The highest mean value of available P_2O_5 was found in Mandvi taluka (53.68 kg/ha) followed by Mundra (47.77 kg/ha) and Rapar (45.14 kg/ha) talukas. The lowest mean value was found in soil of Abadasa taluka (28.90 kg P_2O_5/ha). The medium status of available phosphorus in these soils might be due to regular application of phosphatic fertilizers to realize higher yields of oil seeds, which are the principal crops of the area. Similar results were obtained for soils of Tonk district of Rajasthan (Meena *et al.,* 2006). Available P_2O_5 showed negative correlation with pH (r = -0.066) and EC (r = -0.011). Similar result obtained for soils of Ausa tahsil of Latur district (Waghmare *et al.,* 2009).

The nutrient index value for available potassium was ranged from 2.25 to 2.90 with mean value 2.54 which indicate that available potassium content high in Kachchh soil. Available potassium in soil varied widely from 107.52 to 954.24 kg K_2O/ha with an average value of 330.86 kg/ha. The highest mean value for available K_2O was found in Abadasa taluka (517.44 kg/ha) followed by Lakhpat taluka (418.66 kg/ha) and Gandhidham taluka (343.88 kg/ha). The lowest mean value of available K_2O was found in Mandvi taluka (242.27 kg/ha). The high available potassium content in these soils might be attributed to the prevalence of potassium rich minerals like feldspars and muscovite and high potassic fertilizers use. Similar results were also obtained for salt affected soils in Amethi area of Uttar Pradesh (Chaudhary *et al*., 2006).

Quality of irrigation water

Among all talukas of Kachchh district the water samples of Mundra taluka had highest mean EC. pH, Na and CO_3+HCO_3 which was followed by Mandvi taluka and Rapar taluka have highest amount of Ca^+ Mg which was followed by Lakhpath taluka. Highest mean chloride was found in samples of Mandvi taluka which was followed by Mundra taluka. Highest mean fluoride was found in Gandhidhan taluka followed by Lakhpath and Abdasa taluka. Two samples of Rapar taluka and one samples of Lakhpath taluka was found above the critical limits (Table 6 & 7).

RSC of most of the water samples of Kachchh was observed safe (88.89%), only 5.15 and 5.96 percent samples are categorized under Marginal and unsafe categories, respectively. Samples of Mundra taluka have highest percentage of RSC levels followed by Mandvi and Bhuj talukas. (Table 10) Chloride concentration of Kachchh water samples were high, among all samples 25.56, 24.14, 27.64, 13.83 and 7.86 percent samples are categorized under unsafe, doubtful, permissible, good and excellent categories, respectively. Highest unsafe chloride concentration was found in Mandvi taluka followed by Gandhidham, Mundra, Bhachau and Rapar talukas respectively. (Table 11)

Water samples of Kachchh district have high soluble salts which have 63.29, 32.52 and only 3.79 percent samples under very high salinity, high salinity and medium salinity classes, respectively and non of the samples were found under low salinity category. Highest salinity was recorded in Mundra taluka followed by Rapar, Mandvi, Gandhidham and Abdasa talukas respectively. (Table 8) 56.10 percent samples of Kachchh district was found having low sodium hazards (S1), 30.62 percent under medium sodium hazards, 11.92 percent high sodium hazards and only 1.36 percent samples were found under sodium category, Among all talukas Mundra taluka have highest sodium hazards which is followed by Mandvi and Abdasa. (Table 9)

Under ground water of Kachchh district have high soluble salts among these samples 63.29 percent samples had very high salinity (C_4 class), 32.52 percent had high salinity (C_3 class) and only 3.79 percent samples were found under medium salinity classes. Among all talukas of Kachchh district Mundra (76.64%) have highest salinity which was followed by Rapar (76.47%), Mandvi and Gandhidham (75%), Lakhpath (65.31%), Bhachau (63.64%), Nakhtrana (50%), Bhuj (42.11%) and Anjar (38.88%). (Table 8)

Table 1 : Measured pH of collected soil samples

Sr. No.	pH value	No. of soil samples	% of samples
1	6.6-7.3	7	1.75
2	7.4-7.8	41	10.25
3	7.9-8.4	250	62.50
4	8.5-9.0	91	22.75
5	>9.0	11	2.75

Table 2 : Saline conditions and categories of crop tolerance

Sr. No.	EC (dS/m)	Category	No. of soil samples	% of samples
1	< 1.0	Normal	359	89.75
2	1.0-2.0	Tending to become saline	32	8.00
3	2.0-3.0	Saline	2	0.50
4	> 3.0	Highly saline	7	1.75

Table 3 : Chemical characteristics of the soils of Saharsa district

Sr. No.	Soil characteristic	Mean	Range
1	Organic carbon (%)	0.35	0.08-0.99
2	Available N (kg ha $^{-1}$)	193.93	62.72-392.00
3	Available P_2O_5 (kg ha^{-1})	41.85	16.81-116.58
4	Available K_2O (kg ha^{-1})	330.86	107.52-954.24

Table 4 : Correlation amongst the different soil parameters under study

	EC	pH	OC	Avail. N	Avail. P	Avail. K
EC	1					
pH	-0.028	1				
OC	0.017	0.193**	1			
Avail. N	0.045	0.178**	0.842**	1		
Avail. P	-0.011	-0.066	-0.040	-0.029	1	
Avail. K	0.029	0.052	-0.097*	-0.071	-0.035	1

*Correlation is Significant at 5 per cent level **Correlation is Significant at 1 per cent level

Table 5 : Nutrient index values and fertility status of nutrient in soils of Kachchh district

Name of Taluka	Nutrient Index Values			Fertility Status		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O
Bhachau	1.03	1.68	2.75	Very low	Marginal	Very high
Rapar	1.08	1.88	2.53	Very low	Marginal	High
Gandhidham	1.35	1.83	2.65	Low	Marginal	High
Anjar	1.28	2.03	2.48	Very low	Adequate	High
Mundra	1.20	1.93	2.38	Very low	Marginal	High
Mandvi	1.25	1.98	2.25	Very low	Marginal	Adequate
Bhuj	1.20	1.95	2.28	Very low	Marginal	Adequate
Nakhatrana	1.05	1.90	2.50	Very low	Marginal	High
Lakhpat	1.08	1.77	2.68	Very low	Marginal	Very high
Abadasa	1.05	1.45	2.90	Very low	Low	Very high
District	**1.16**	**1.67**	**2.54**	**Very low**	**Marginal**	**High**

Table 6 : Range and mean values of EC, pH, Na and Ca+Mg, in water samples of different talukas of Kachchh District

Sr. No.	Taluka	No. of Samples	EC µmhos/cm		pH		Na (mel/l)		Ca+Mg (mel/l)	
			Range	Mean	Range	Mean	Range	Mean	Range	Mean
1	Bhachau	44	1200-8100	2999.27	7.27-8.98	8.22	3.61- 48.35	21.21	3.0-52.9	14.05
2	Rapar	68	450-11200	3994.68	7.25-8.90	8.00	1.65-71.91	30.47	3.2-60.5	26.04
3	Abdasa	40	710-10000	3550.25	7.85-9.28	8.47	13.30-73.78	29.82	2.9-21.9	10.73
4	Lakhpath	49	700-6900	3448.57	7.77-8.99	8.25	8.26-71.91	34.50	3.0-46.2	23.01
5	Nakhtrana	28	700-5000	2378.57	7.45-8.89	8.32	13.3-40.96	22.74	5.5-30.2	12.83
6	Anjar	36	680-5000	2174.44	8.00-8.72	8.35	4.17-49.35	15.64	4.0-26.9	8.52
7	Bhuj	38	690-4900	2414.47	7.13-9.17	8.36	3.3-39.96	14.20	2.0-27.3	9.44
8	Mundra	30	1700-11900	4469.48	8.15-9.36	8.54	15.7-66.09	35.65	3.6-45.4	10.14
9	Mandvi	28	1400-10500	4350.22	7.98-9.30	8.52	1.61-73.00	33.82	1.5-34.7	10.39
10	Gandhidham	08	1100-4500	3487.5	8.1-9.05	8.40	19.04-38.91	28.77	2.9-17.7	10.64
District:-		369								

Table 7 : Range and mean values of CO_3+HCO_3, Cl, and F content in water samples of different talukas of Kachchh District

Sr. No.	Taluka	No. of Samples	CO_3+HCO_3 (meq/l)		Cl (meq/l)		F (ppm)	
			Range	Mean	Range	Mean	Range	Mean
1	Bhachau	44	0.6-4.95	2.38	4.0-30.5	13.94	0.25-1.50	0.68
2	Rapar	68	0.4-3.41	1.67	0.75-80.5	21.64	0.2-1.47	0.69
3	Abdasa	40	0.99-5.45	2.95	3.5-54.25	19.04	0.25-1.48	0.73

4	Lakhpath	49	0.4-8.11	2.36	0.8-65.75	22.59	0.25-1.46	0.77
5	Nakhtrana	28	1.3-6.71	3.30	3.2-26.25	12.48	0.2-1.45	0.54
6	Anjar	36	1.1-6.72	3.16	3.7-30.25	10.04	0.35-1.25	0.62
7	Bhuj	38	1.0-11.38	3.34	3.1-26.25	10.70	0.22-1.42	0.52
8	Mundra	30	1.1-6.16	3.45	4.5-38.75	23.26	0.2-1.25	0.49
9	Mandvi	28	0.9-7.8	3.42	3.0-71.25	23.64	0.2-1.3	0.52
10	Gandhidham	08	0.98-5.2	2.42	7-45.75	18.71	0.45-1.48	0.81
District:-		369						

Table 8 : Distribution of water samples according to total concentration of soluble salts in different talukas of Kachchh District.

Sr. No.	Taluka	No. of samples	EC (µmhos/cm)			
			0-250	250-750	750-2250	>2250
			C_1 - Low salinity	C_2 - Medium salinity	C_3 - High Salinity	C_4 - Very High Salinity
1	Bhachau	44	-	02 (4.5)	14 (31.82)	28 (63.64)
2	Rapar	68	-	02 (2.94)	14 (20.59)	52 (76.47)
3	Abdasa	40	-	02 (5)	09 (22.5)	29 (72.5)
4	Lakhpath	49	-	02 (4.08)	15 (30.61)	32 (65.31)
5	Nakhtrana	28	-	02 (7.14)	12 (42.86)	14 (50)
6	Anjar	36	-	03 (8.33)	19 (52.78)	14 (38.88)
7	Bhuj	38	-	01 (2.63)	21 (55.26)	16 (42.11)
8	Mundra	30	-	-	07 (23.34)	23 (76.64)
9	Mandvi	28	-	-	07 (25)	21 (75)
10	Gandhidham	08	-	-	02 (25)	06 (75)
District:-		369	-	14 (3.79)	120 (32.52)	235 (63.69)

*Bracket value shows the percentage distribution of water samples

Table 9 : Distribution of water samples accords to sodium hazards (SAR) in different talukas of Kachchh District.

Sr. No.	Taluka	No. of samples	SAR			
			0-10	10-18	18-26	>26
			S_1 - Low sodium hazard	S_2-Medium sodium hazard	S_3-High sodium hazard	S_4- Very High sodium hazard
1	Bhachau	44	30 (68.18)	11 (25)	03 (6.82)	-
2	Rapar	68	48 (70.59)	17 (25)	03 (4.41)	-
3	Abdasa	40	13 (32.5)	18 (45)	8 (20)	01 (2.5)
4	Lakhpath	49	23 (46.94)	26 (53.06)	-	-
5	Nakhtrana	28	16 (57.14)	12 (42.86)	-	-
6	Anjar	36	31 (86.11)	05 (13.89)	-	-
7	Bhuj	38	32 (84.21)	05 (13.16)	01 (2.63)	-
8	Mundra	30	03 (10)	09 (30)	16 (53.33)	02 (6.67)
9	Mandvi	28	09 (32.14)	06 (21.73)	11 (39.29)	02 (3.57)
10	Gandhidham	08	02 (25)	04 (50)	02 (25)	-
District:-		369	207 (56.10)	113 (30.62)	44 (11.92)	05 (1.36)

* Bracket value shows the percentage distribution of water samples

Table 10 : Distribution of water samples according to bicarbonate hazards (meq/l) in different talukas of Kachchh District.

Sr. No.	Taluka	No. of samples	RSC (meq/l)		
			<1.25	1.25-2.5	>2.5
			Safe	Marginally safe	Unsafe
1	Bhachau	44	40	02	02
2	Rapar	68	63	02	03
3	Abdasa	40	37	02	1
4	Lakhpath	49	47	02	-
5	Nakhtrana	28	26	01	01
6	Anjar	36	33	03	-
7	Bhuj	38	31	03	04
8	Mundra	30	21	03	06 (20)
9	Mandvi	28	22	01	05
10	Gandhidham	08	08	-	-
District:-		369	328 (88.89)	19 (5.15)	22 (5.96)

* Value shown in bracket indicates percentage distribution of samples

Table 11 : Distribution of water samples according to chloride concentration (meq/l) in different talukas of Kachchh District.

Sr. No.	Taluka	No. of samples	Cl (meq/l)				
			0-4	4-7	7-12	12-20	>20
			Excellent	Good	Permissible	Doubtful	Unsafe
1	Bhachau	44	2 (4.55)	3 (6.82)	15 (34.09)	10 (22.72)	14 (31.82)
2	Rapar	68	3 (4.41)	4 (5.88)	18 (26.47)	22 (32.86)	21 (30.88)
3	Abdasa	40	2 (5)	5 (12.5)	10 (25)	11 (27.5)	12 (30)
4	Lakhpath	49	2 (4.08)	5 (10.3)	12 (24.49)	15 (27.5)	15 (30)
5	Nakhtrana	28	2 (7.14)	6 (21.43)	12 (42.86)	5 (17.86)	3 (10.71)
6	Anjar	36	6 (16.67)	10 (27.10)	10 (27.10)	7 (19.44)	3 (8.33)
7	Bhuj	38	7 (18.42)	08 (21.05)	10 (26.32)	8 (21.05)	5 (13.16)
8	Mundra	30	2 (6.67)	04 (13.33)	08 (26.67)	6 (20)	10 (33.13)
9	Mandvi	28	3 (10.71)	05 (17.86)	05 (17.86)	3 (10.71)	12 (42.86)
10	Gandhidham	08	-	01 (12.5)	02 (25)	02 (25)	03 (37.5)
District:-		369	29 (7.86)	51 (13.82)	102 (27.64)	89 (24.12)	98 (25.56)

*Value shown in bracket indicates percentage distribution of samples

Conclusions

The soil survey data of Kachchh district clearly indicates that the soils were moderately alkaline to very strongly alkaline in reaction with soluble salt content under slightly saline category. The soils of Kachchh district were low in organic carbon content and available nitrogen, medium in available phosphorus and high in available potassium status. On the basis of overall nutrient index, the soils of Kachchh district were very low in available nitrogen, marginal in available phosphorus and high in available potassium status.

And also concluded that water samples have less sodium hazards compared to salinity hazards because it have 56.10, 30.65 11.93 and 1.36 percent samples under low, medium, high and very high categories, respectively. Among all talukas Mundra (53.33%) have highest sodium hazards which are followed by Mandvi (39.29%), Gandhidham (25%) and Abdasa (20%). (Table 4) RSC of most of the water samples of Kachchh are observed safe (88.89%), only 5.15 and 5.96 percent samples are categorized under Marginal and unsafe categories, respectively. (Table 5) Chloride concentration of Kachchh water samples is high, among all samples 25.56, 24.14, 27.64, 13.83 and 7.86 percent samples are categorized under unsafe, doubtful, permissible, good and excellent categories, respectively. None of the water samples of Kachchh have fluoride content above critical limit (<1.5 ppm) (Table 6).

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