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Agricultural Soil Study through Electrical Coductivity and their Relationship with Micronutrients of Bhuj Region in Kutch District

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Abstract:
Agriculture soils 1500 samples representing fifty villages of Bhuj tehsil of Kutch district in Gujarat state were investigated. . All samples were collected from Government of Gujarat under soil health card programme. Soil samples were collected by authorized locally trained farmers and brought for analysis to Soil Test Laboratory of Bhuj. Standard Methods were applied for the soil analysis. Soil parameters, namely pH, EC, C, P, K, Fe, Cu, Zn, Mn, Ca, Mg, S were considered for study and analysis. The purpose of this paper is to evaluate agricultural soil through electrical conductivity and their relationship with micronutrients. Discriminate analysis and Correlation analysis are used for statistical data treatment. In this study the electrical conductivity of all samples (100%) is in salt free (0-2) range and it shows that the study area fairly good for agriculture. The result shows that the available micronutrients Cu, Zn and Mn are positively correlates while as Fe negatively correlates with electrical conductivity. This work concludes that the application of statistical analysis can give a scientific stand for agriculture soil fertility management.

Key words: *Bhuj, Electrical conductivity, Kutch, Micronutrients, Soil parameter*

1. Introduction

Soil is a basic component of the morden and scientific tillage so that it is necessary to determine the basic needs of soil. Agriculture soil quality is that the ability of a soil to perform the functions necessary for its intended use. The quality of soil is evaluated using soil properties. Soil properties includes physical and chemical properties as well as macro- micro nutrients. Soil is natural resource that provides essential nutrients to crope growth, need proper care, conservation and management in order to maintain a high degree of soil fertility system. One of the ways to assess the soil fertility status is to get soil sample tested for different soil nutrients. Statistical analysis, as a powerful tools, can provide such information and assist the interpretation of soil tested data [1-2].

The objective of this work is:

- An application of selected Descriptive statistical tool to study and analysis of soil parameters.
- Soil quality analysis through electrical Conductivity
- To determine the correlation of electrical conductivity(EC) with micronutrients (Fe, Cu, Zn and Mn)

Pearson's correlation is applied to 1500 medium black soil samples from different 50 village's agricultural area (30 samples from each village) of Bhuj region of Kutch district [3-8].

2. Material and Methods

2.1. The study area

The study location covers agricultural land of 50 villages of Bhuj tehsil of Kutch district. Kutch is a district of Gujarat state in Western India, covering an area of 45,652 km². [9] The district lies in the extreme west of India between 22^0 44' to 24^0 41 North latitude 68^0 7' to 71^0 46 East Longitude [10]. The temperature range is 45ºC (max.) and 4ºC (min.). Average rainfall is 587 mm. Bhuj tehsil was struck by major earthquake on 21 July 1956 as well on 26 January 2001, which caused a great deal of damage and loss of life and property.

Major soils [11] are medium black, sandy and hydromorphic type. Major field crops are groundnut, bajra, castor, green gram, wheat, cotton, moth bean and major horticultural crops are mango, , papaya, cucurbits, sapota, banana [12].

From the collected data at different science colleges and STL under the soil health card program by the government of Gujarat, India, we have selected 1500 medium black soil samples based on cotton crop from different regions of Bhuj tehsil of Kutch district (Gujarat–India) for this study. All selected samples represent 50 villages (30 samples from each) of Bhuj.(table-2) Numbers of soils samples, names of villages and village code shown in table 2. Location of study area and village code of 1500 samples are shown in location map figure 1.

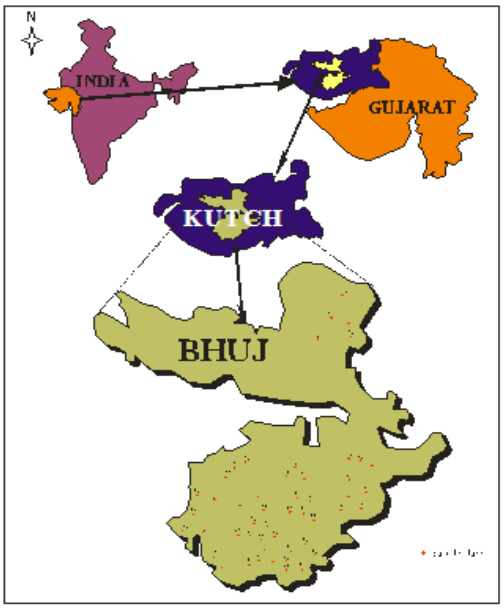

Figure 1: Location map of study area, Bhuj tehsil of kutch district, Gujarat, India

2.2. Soil sampling and analysis

Soil samples were sampled by a systematic sampling strategy at 0 to 20 cm depth below the surface. The samples were dried and passed through a 2 mm sieve to prepare them for testing. All the samples were tested using standard method by following the "Methods Manual-Soil Testing in India"[13]. All the samples were tested and analyzed for soil properties like organic carbon (OC), phosphorus (P), potassium (K), electrical conductivity (EC), pH. Fe (Iron), Cu(Copper), Zn(Zinc), Mn(Manganese), Ca(Calcium), Mg(Magnesium), and S(Sulfar).

2.3. Tools and techniques

Minimum, maximum, mean, median, mode,standard deviation (SD) and variance are calculated for measured soil properties. Descriptive statistical analysis and Pearson's correlation analysis are used to analyze soil samples data. Variables employed for analysis in this study include organic carbon (OC), phosphorus (P), potassium (K), electrical conductivity (EC), pH. Fe (Iron), Cu(Copper), Zn(Zinc), Mn(Manganese), Ca(Calcium), Mg(Magnesium), and S(Sulfar). Using MATLAB and EXCEL all statistical analysis are performed using.

3. Results and Discussion

Soil properties (pH, EC, C, P, K, Fe, Cu, Mn, Zn Ca, Mg, and S) and descriptive statistics of soil analysis is shown in table 1. Statistical analysis is done using Pearson correlation method. Chemical analysis of collected soil samples shows pH range maximumn (9.9) and Minimum (6.8). Soils are neutral to alkaline in reaction, pH varied from 6.8 to 9.9 with the mean value of 7.59, median of 7.6. Electrical conductivity (EC) is varied from 0.08 to 0.99 dSm^{-1} with a mean value of 0.4 $dSm^{-1}$and median o.37 dSm^{-1}. All samples (100%) are salt free i.e. values are between 0 - 2 (ref: table 3 and 2). Organic carbon (OC) of the soil is varied from 0.03 – 0.99 % with a mean value of 0.52 % and median 0.53% given in table-1. Phosphorus content of studied samples is 3–387 kg/ha with mean and median value 40 and 34 kg/ha .Potassium (K) range 28-810 kg/ha with mean 274 and 271 kg/ha shows high value in study area. Sulfur content range 22.32 – 49.60 ppm with mean and median 35.96 and 34.72 ppm. High Phosphorous(P), Potassium (K) and sulfur(S) values shows excess fertilizer application in soil.

Sr. No	Soil parameters	Unit	Total samples (N)	Minimum	Maximum	Mean	Median	Mode	Standerd deviation	Variance
1	pH		1500	6.80	9.90	7.59	7.60	7.60	.27	.08
2	EC	dS/m	1500	.08	.99	.40	.37	.23	.19	.04
3	C	%	1500	.03	.99	.52	.53	.54	.17	.03
4	P	Kg/ha	1500	3.00	387.00	40.38	34.00	27.00	23.55	554.46
5	K	Kg/ha	1500	28.00	810.00	274.69	272.00	236.00	62.52	3908.89
6	Fe	ppm	1500	1.00	5.20	2.84	2.50	2.50	1.09	1.19
7	Cu	ppm	1500	.20	.80	.39	.36	.25	.15	.02
8	Mn	ppm	1500	2.00	8.00	4.71	4.50	4.50	1.48	2.19
9	Zn	ppm	1500	.20	35.00	4.61	4.50	4.50	2.93	8.57
10	Ca	Meq/100gm	1500	7.00	15.40	11.57	12.40	14.20	2.61	6.83
11	Mg	Meq/100gm	1500	2.00	8.50	5.26	5.20	4.50	1.51	2.28
12	S	ppm	1500	22.32	49.60	35.96	34.72	34.72	6.19	38.28

Table 1: Discriptive statistics of the distribution of soil parameters

VC	Name of Village	TS	Electrical Conductivity in Samples				VC	Name of Village	TS	Electrical Conductivity in Samples			
			SF	SS	MS	HS				SF	SS	MS	HS
1	Payarka	30	30	0	0	0	**26**	Reldi Nani	30	30	0	0	0
2	Kera	30	30	0	0	0	**27**	Mamuyara	30	30	0	0	0
3	Baladiya	30	30	0	0	0	**28**	Nadapa	30	30	0	0	0
4	Vadzar	30	30	0	0	0	**29**	Dhaneti	30	30	0	0	0
5	Zumkha	30	30	0	0	0	**30**	Nagor	30	30	0	0	0
6	Fotdi	30	30	0	0	0	**31**	Purasar	30	30	0	0	0
7	Sukhapar	30	30	0	0	0	**32**	Kandheray	30	30	0	0	0
8	Godsar(Rakhal)	30	30	0	0	0	**33**	Ukhadamora	30	30	0	0	0
9	Mirzapar	30	30	0	0	0	**34**	Sedata	30	30	0	0	0
10	Kalyanpar	30	30	0	0	0	**35**	Bandhara Mota	30	30	0	0	0
11	Ratiya	30	30	0	0	0	**36**	Kanpar	30	30	0	0	0
12	Madhapar	30	30	0	0	0	**37**	Mokhana	30	30	0	0	0
13	Ler	30	30	0	0	0	**38**	Jam kunariya	30	30	0	0	0
14	Bhujodi	30	30	0	0	0	**39**	Zura	30	30	0	0	0
15	Gada	30	30	0	0	0	**40**	Mankuva	30	30	0	0	0
16	Traya	30	30	0	0	0	**41**	Kurbai	30	30	0	0	0
17	Varli	30	30	0	0	0	**42**	Modsar	30	30	0	0	0
18	Tharavda	30	30	0	0	0	**43**	Lakhod	30	30	0	0	0
19	Kotda Athamana	30	30	0	0	0	**44**	Makhna	30	30	0	0	0
20	Jambudi	30	30	0	0	0	**45**	Natharkui	30	30	0	0	0
21	Bandhra Nana	30	30	0	0	0	**46**	Vyara	30	30	0	0	0
22	Bharapar	30	30	0	0	0	**47**	Varnora nana	30	30	0	0	0
23	Naranpar ravari	30	30	0	0	0	**48**	Juna	30	30	0	0	0
24	Naranpar Pasayati	30	30	0	0	0	**49**	Ghoravar	30	30	0	0	0
25	Reldi Moti	30	30	0	0	0	**50**	Bada	30	30	0	0	0

Table 2 : Electrical Conductivity in the agriculture soil of Bhuj region in kutch district
VC = Village Code, TS = Total Samples, SF = Salt free, SS = Slightly saline, MS = Moderately saline, HS = Highly saline

Parameters	Interpretation		Parameters	Interpretation			Soil Properties	Correlation Coefficient (r)
pH	< 4.6	Extremely acidic	**Fe ppm**	0.0 - 2.0	Very Low			
	4.6 - 5.5	Strongly acidic		2.0 - 4.0	Low		EC - Fe	-0.054
	5.6 - 6.5	Moderately acidic		4.0 - 6.0	Medium			
	6.6 - 6.9	Slightly acidic		6.0 - 10	High		EC - Cu	0.079
	7	Neutral		> 10	Very High			
	7.1 - 8.5	Moderately alkaline	**Cu ppm**	0.0 - 0.1	Very Low		EC - Zn	0.27
	>8.5	Strongly alkaline		0.1 - 0.3	Low			
EC dS/m	0 - 2	Salt Free		0.3 - 0.8	Medium		EC - Mn	0.001
	4 - 8	Slightly Saline		0.8 - 3	High			
	8 - 15	Moderately Saline		> 3.0	Very High		*Table 4. Correlation coefficients Of Electrical conductivity And micronutrients*	
	> 15	Highly Saline	**Zn ppm**	0.0 - 0.5	Very Low			
OC %	<0.5	Low		0.5 - 1.0	Low			
	0.5- 0.75	Medium		1.0 - 3.0	Medium			
	> 0.75	High		3.0 - 5.0	High			
P Kg/ha	< 10.0	Low		> 5.0	Very High			
	10 - 24.6	Medium	**Mn ppm**	0.0 - 0.5	Very Low			
	> 24.6	High		0.5 - 1.2	Low			
K Kg/ha	< 108	Low		1.2 - 3.5	Medium			
	108- 280	Medium		3.5 - 6	High			
	> 280	High		> 6	Very High			
S %	8 to 10		**Ca Meq/100gm**	6.0 to 18.0				
			Mg Meq/100gm	2.0 to 10.0				
Table 3. Critical limit of Soil properties (followed by MMSOIL-Gov. of India-2011)								

It is observed that Ca(Calcium) and Mg(Magnesium) are in sufficient range i.e. Ca(Calcium) range and Mg(Magnesium) range 7.0 to 15.40 Meq/100gm respectively, which is considerable in soil of study area.
The available Micronutrients Iron(Fe) contents of the soils is minimum 1.0 ppm and maximum 5.2 ppm with mean value 2.84. As per critical limit ref. table 3, the soils of the study area appeared to be quite sufficient in available Fe.
The available (Cu) content of the soils is minimum 0.20ppm and maximum 0.80ppm with mean 0.39. According to Critical limit all samples are quite sufficient in available Cu.
The available Zinc (Zn) varied from 0.20 ppm to 35 ppm. Looking to mean value 4.61 ppm and median 4.50 ppm, it shows that all the soils contain adequate amount of available Zn.
The available Mn(Manganese) content of soils is minimum 2.0 ppm and maximum 8.0 ppm with mean and median 4.71 ppm and 4.50 ppm respectively. Considering the critical limit suggested by MMSOIL [13], the soils of study area appears to sufficient in Mn.

3.1. Relation of EC with micronutrients
Correlation coefficient (r) is given in table-4. Correlation studies of EC with Micronutrient Fe (Iron) shows Less negative relationship with r = -0.054, where as positive but not very significant correlation with Mn(Manganese) (r = 0.001), while positive but not significant correlation with Cu(Copper)(r = 0.079 Electrical conductivity is highly correlated with Zn(Zinc) (r = 0.27)

4. Conclusion

- Observation shows positive significant correlation of EC with Zinc.
- Electrical conductivity has positive but not significant correlation with Manganese and Copper.
- Organic carbon has high degree of positive correlation with potassium.
- Electrical conductivity inversely correlate with Iron.
- Present Study shows that the study area is free from salt.
- Very high value of Sulfur indicates use of intensive agriculture practices.
- EC and pH of study area are fairly good for agriculture.
- Present study concludes that statistical methods e.g. correlation analysis can provide a scientific basis for controlling and monitoring agriculture soil fertility management.

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6. References

1. Sena, M.M., R.T.S. Frighetto, P.J. Valarini, H. Tokeshi and R.J. Poppi, 2002. Discrimination of management effects on soil parameters by using principal component analysis: A multivariate analysis case study. Soil and Tillage Research, 67: 171-181.
2. Einax, J.W. and U. Soldt, 1999. Geostatistical and multivariate statistical method for the assessment of polluted soils; Merits and limitations. Chemometrics Intell. Lab., 46: 79-91.
3. Patel Prakash L.,Patel Nirmal P., Patel Prakash H. and Gharekhan Anita. Correlation studyof Soil Parameter of Kutch district Agriculture land.International Journal of Scientific and Research Publications 2014,Volume-IV,Issue-V,p2989.
4. Vijayakumar R, Arokiaraj A, Martin DP. Micronutrients and their Relationship with Soil Properties of Natural Disaster Proned Coastal Soils. Res J Chem Sci. 2011;1(1):8-12
5. Mico C, Recatala L, Peris M, Sanchez J. Assessing heavy metal sources in agricultural soil of an European Mediteranean area by multivariate analysis. Chemoshere 2006;65:863-72
6. Mali VS, Zende NA, Verma UK. Correlation between soil physic-chemical properties and available micronutrients in salt effected soils, 17th WCSS 2002;Thailand
7. Gharekhan A, Oza AN, Sureshkumar MB, Pradhan A, Panigrahi PK. Study of polarized spectral features of human breast tissues through wavelet transform and principal component analysis. Pramana - Journal of Physics 2010;75(6):1281-6
8. Gharekhan A, Arora S, et al. Distinguishing auto-fluorescence of Normal, Benign and Cancerous Breast Tissues through Wavelet Domain Correlation Studies. Journal of Biomedical Optics 2011;16(8):087003 Also published in Virtual Journal of Biological Physics Research 2011;22(4)
9. Kutch. vibrantgujarat.com
10. www.indianetzone.com
11. Soils of Gujarat - http://goo.gl/CF9Rb
12. Agriculture Contingency Plan for District, Kutch, Gujarat.
13. “Methods Manual-Soil Testing in India”, Department of Agriculture & Cooperation Ministry of Agriculture Government of India 2011