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STUDY OF MICRONUTRIENTS THROUGH STATISTICAL DATA TREATMENT OF AGRICULTURAL SOIL OF BHUJ AND MANDVI SITES IN KUTCH DISTRICT

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ABSTRACT

In this research paper, selected statistical methods like discriminate analysis, ANOVA and Correlation analysis were used to find out the difference in the soil property of the two investigated sites of agricultural land. Site 1 is located towards dessert and site 2 located towards coastal region of Kutch district of Gujarat state in western India. With the help of discriminate analysis and one way ANOVA, we discovered that two investigated sites are different in terms of micro nutrition (Fe, Cu, Mn, Zn). Descriptive statistic (Mean) indicated that site 1 possess low micro nutrition with comparison of sites 2. Correlation analysis discovered that all micronutrients are moderate to highly correlate with each other. This study concludes that statistical analysis provides scientific bases for difference in the soil property especially in micro nutrition.

KEYWORDS: ANOVA, Bhuj, Correlation Analysis, Mandvi, Micronutrients

INTRODUCTION

Agriculture plays a vital role in the economy of India. Tillage management depend on soil quality. Soil quality maintenance depends on soil physico-chemical properties and macro-micronutrients. Soil is an important component of the scientific tillage so that it is necessary to evaluate the basic requirements 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 through soil properties and macro-micronutrients. 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 methods like discriminate analysis, ANOVA and Correlation analysis, as a powerful tools, can provide such information and assist the interpretation of soil tested data [1-2]

This paper mainly focused on the following objectives

- An application of descriptive statistical tools to study and analysis of soil parameters.
- To determine the correlation in micronutrients of site 1 and site 2.

ANOVA and Pearson's correlation is applied to 50 soil samples from different two sites (25 samples from each site) of Kutch district [3-8].

MATERIAL AND METHODS

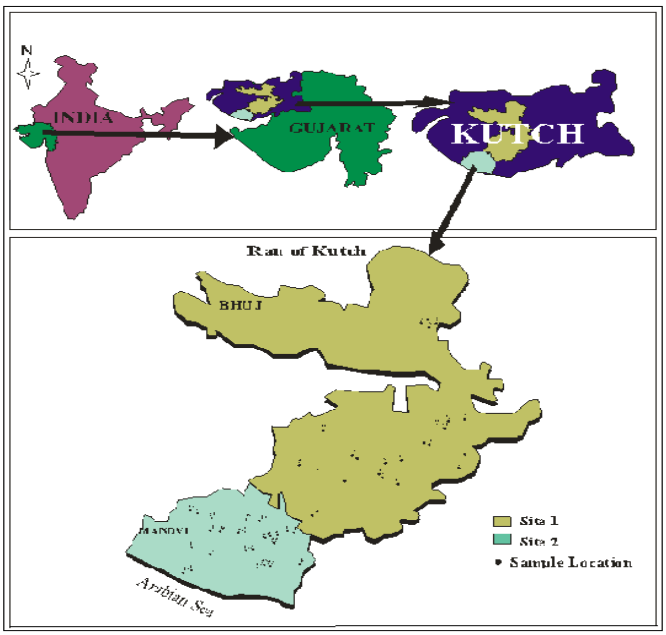

Figure 1: Study Area: Location Map

The Study Area

The study area is agricultural land of Kutch district. Specially two sites are selected for investigation. Site 1 (Bhuj tahsil) is located near coastal region and site 2 (Manvi tahsil) is located near dessert. The area under investigation lies in Kutch district of Gujarat state in Western India, covering an area of 45652 km^2. [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]. Maximum and minimum temperature range is 45^0C to 4^0C. Average rainfall is 587mm. Kutch is virtually an island, as it is surrounded by the Arabian Sea in the west, by the Gulf of Kutch in south and southeast by Dessert of Kutch in north and northeast. Study area was struck by major earthquake on 26 January 2001. The border with Pakistan lies along the northern edge of the Rann of Kutch.

In this area major soils are medium black, sandy, and hydromorphic type. [11] Major Field crops are Groundnut, Bajra, Castor, Greengram, Wheat, Cotton, Mothbean, Mung and major hostricultural crops are Mango, Papaya, Cucurbits, Sapota, Banana. [12]

From the collected data at different science colleges and STL under soil health card program by the government of Gujarat, India, we have selected 50 soil samples (25 from each site) based on different crops for this study.

Locations of study area and samples sites are shown in figure 1

Soil Sampling and Analysis

Soil samples were collected by systematic sampling method 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. Using standard methods all the samples were tested by following "Methods manual- Soil testing of India" [13]. All the samples were tested and analyzed for soil properties. Same study was reported for other location by M.Kumar [14] and Wajahat Nazif [15].

Tools and Techniques

A Pearson's correlation analysis is used to confirm the relationship among basic soil properties (pH and EC) and Micronutrients (Fe, Cu, Mn and Zn) [16]. Total 50 samples are considered for study and analysis. Maximum, Minimum, Mean, Median, Mode and Standard deviation are calculated for soil parameters.

Discriminant Analysis

To find out in the difference in the micro nutrition of the two investigated sites, discriminate analysis was used. In the discriminate analysis with the help of canonical correlation, Wilk's lambda and percentage of original group correctly classified the statistical conclusion were drawn.

One Way ANOVA

One way ANOVA used to find out difference in the means level of the four micro nutrients (Fe, Cu, Mn and Zn). All micro nutrition was treated as the testing variable and the site location was treated as grouping variable. Further the mean was used to give more informative conclusion.

Correlation

To find out the inter correlation between all four micro nutrition of the soil, Pearson correlation was used which revels the positive and significant correlation.

All statistical methods used in the research papers is parametric. And these paramateric methods have some assumption about the population. All the data are normally distributed means they are drawn from the normally distributed population.

For the ANOVA, Levine test was performed to check homogeneity of variance it found equal variance for both site. Level of significant was 5% for discriminate and ANOVA and in correlation 1 %. All statistical analysis was performed using SPSS 16.

RESULTS AND DISCUSSIONS

The soil samples from both sites under study reveal varying assiduities of all four analyzed micro nutrition of the soil (Table 1). There are also noticeable differences in the assiduities of four micro nutrition of soil. Using the site as a reference it was found that site which was near to see level content significantly higher assiduousness of soil nutrition compared with other soil samples. The studied four micro nutrition found significantly correlated with each other.

Table 1: Soil Property of the Investigated Sites

Sample No.	Ph	Ec	Oc	P	K	S	Fe	Cu	Mn	Zn	Ca	Mg
S-1	7.8	0.56	0.26	38	162	34	1	0.32	2.5	0.25	14.2	4.5
S-2	7.7	0.39	0.16	23	224	34.72	2	0.25	4	2	15.4	4.3
S-3	7.7	0.19	0.27	65	204	42.16	2	0.32	2.6	0.78	12	4.5
S-4	7.8	0.14	0.67	34	216	34.72	1.4	0.25	3.5	3.5	12.1	6.5
S-5	7.2	0.25	0.54	30	208	44	2.1	0.25	2.6	2.5	14	7
S-6	7.6	0.31	0.41	18	268	37.2	1.5	0.25	3	3.3	14.2	3.5
S-7	7.9	0.18	0.36	25	232	32	2	0.25	3.5	3.5	14.1	3.6
S-8	8	0.22	0.2	36	228	29.76	2	0.23	4	2.6	11	4.6
S-9	7.9	0.57	0.76	34	216	32	1	0.25	3.4	3.5	7.8	4.5

Table 1: Contd.,

S-10	7.8	0.49	0.27	23	256	35	2.1	0.25	3.5	3.5	12.5	6.5
S-11	7.6	0.16	0.43	27	272	27.28	2	0.25	2.6	0.78	12	5.6
S-12	7.1	0.23	0.63	23	212	42.16	1	0.25	2.5	0.85	14.8	4.5
S-13	7.7	0.25	0.58	40	212	32.24	1.2	0.25	2.5	3.5	7.9	4.6
S-14	7.6	0.57	0.58	25	260	32.24	2	0.26	2.4	0.85	14.2	6.5
S-15	7.6	0.36	0.63	25	236	44.64	2	0.25	2.5	3.3	7.8	8
S-16	7.9	0.46	0.72	40	236	42.16	2	0.25	2.5	3.5	15	5
S-17	7.7	0.3	0.57	25	232	42.16	2	0.25	3.5	2.5	8.7	7.5
S-18	7.5	0.52	0.55	27	268	27.28	2	0.25	2.5	0.35	14	5.6
S-19	7.9	0.38	0.61	45	236	34.72	2	0.25	3.6	3.5	9	7
S-20	7.7	0.33	0.27	27	256	37.2	2	0.25	2.5	3.5	14	2.6
S-21	7.4	0.27	0.71	30	212	37.2	1.2	0.25	2.6	3.2	12.4	5.5
S-22	7.6	0.38	0.59	21	150	44.64	2	0.25	3.5	3.5	10.1	6.5
S-23	7.2	0.32	0.2	21	200	32	1.5	0.25	2.5	3.4	13.2	4.5
S-24	7.8	0.23	0.25	25	123	44.64	2	0.25	3.5	3.5	13.5	6.5
S-25	7.8	0.23	0.36	23	236	42	2.1	0.25	2.5	3.5	7.8	6.5
S-26	6.8	0.25	0.2	55	216	27.28	4.5	0.66	5.3	5.6	7.9	3.5
S-27	7.2	0.73	0.59	25	152	25	2.5	0.36	5.2	7.6	8.8	6
S-28	7.5	0.32	0.65	27	180	37.2	3.2	0.36	5.2	7.1	14.9	7.5
S-29	7	0.22	0.67	57	113	45	3	0.53	7.5	5.2	7.9	5.3
S-30	7.2	0.23	0.52	23	235	32.24	4	0.53	5.6	6.2	13.5	4.6
S-31	7.3	0.25	0.23	25	235	35	3.5	0.52	6.3	5.6	13.2	4
S-32	7.3	0.23	0.25	25	213	45.25	2.5	0.56	5.2	5.3	15	5.5
S-33	7.2	0.23	0.52	23	235	29.76	3.5	0.54	7	5.2	7.9	5.6
S-34	7.56	0.25	0.35	23	213	34.72	3.2	0.52	6	5.2	7.9	4.5
S-35	7.4	0.23	0.36	25	235	34	3	0.65	5.2	6	13.2	2.5
S-36	7.6	0.36	0.23	25	235	32.24	3	0.45	5.5	5.3	7.8	7.5
S-37	7.4	0.23	0.63	25	235	24.8	4	0.54	5.4	5.2	8.5	5
S-38	7.5	0.23	0.25	35	235	24	3.2	0.63	5.3	5.6	9.8	2.5
S-39	7.2	0.23	0.25	35	235	24.8	3.5	0.8	5.4	5.2	8.5	5
S-40	7.3	0.23	0.52	23	235	32.24	3.5	0.36	6	6.6	8.7	7.4
S-41	7.6	0.23	0.52	23	235	25	3.2	0.45	6.5	8	9.8	4.6
S-42	7.6	0.25	0.32	23	235	25	3.5	0.45	5.2	5.2	12.5	6
S-43	7.5	0.23	0.63	25	235	32	2.5	0.36	6	5.2	7.8	6.5
S-44	7.96	0.63	0.25	23	236	32.24	4.5	0.36	5.5	5.3	7.8	7.5
S-45	7.2	0.54	0.22	54	125	24.8	4.5	0.45	5.4	5.2	8.5	5
S-46	7.1	0.25	0.31	42	51	41	2.5	0.42	5.2	7.5	14	7
S-47	7.1	0.25	0.31	42	214	24.8	3	0.63	5.4	5.2	8.5	5
S-48	7.2	0.55	0.35	45	225	29.76	2.5	0.45	7	5.2	7.9	5.6
S-49	7.6	0.23	0.63	23	236	25	2.5	0.45	5.6	7.5	14	7.5
S-50	7.6	0.23	0.63	25	123	44.64	4.5	0.55	6.5	5.3	14	5.6

Discriminant Analysis

We applied the discriminant analysis to ascertain whether two studied sites differed significantly in terms of micro nutrition of soil. For to perform, we first entered the two sites as a grouping variable. Four micro nutrition studied variables were also entered as the independent variables.

Table 2: Discriminant Analysis

Variable	Canonica Correlation	Wilk's Lambda Statistic	Chi-Squares	D.F.	Sign.	Percentage of Cases Correctly Classified
Zn	0.839	0.296	57.834	1	0	100

Table 2: Contd.,

Mn	0.92	0.154	88.805	1	0	100
Cu	0.843	0.289	58.995	1	0	96
Fe	0.82	0.327	53,097	1	0	100

The result of the discriminant analysis (shown in Table 2) clearly argues that site 1 and site 2demonstrate difference in soil nutrition. It is apparent that for each micro nutrition under the studies, a high degree of between site variations exist (canonical correlation have values between 0.82 to 0.92), whereas there is a very few lower degree of within-group site variations (Wilk's lambda statistic range from 0.154 to 0.327).

Generally, the higher the canonical correlation value, the larger between groups variation as a proportion of the total variation and the higher the Wilk's lambda value, the larger is the within-group variation as a proportion of the total variation. The statistically significant answers also indicate that the originally grouped cases have very high percentage.

ANOVA Analysis

One way ANOVA was performed to find out the difference in the soil nutrition of two sites. Although the discriminant provides the significant difference but ANOVA provides the more strengthen to the result of the discriminant analysis. For the one way ANOVA all four micro nutrition entered as a testing variable and site location variable treated as the grouping variable.

The result of the one way ANOVA present in the Table 3 provides the significant difference in the mean level of micro nutrition of two difference sites. The conclusion of the ANOVA is same as the discriminant analysis.

Table 3: One Way Anova

Micronutrients	Classification	Sum of Squares	Df	Mean Square	F	Sig.
Fe	Between Groups	30.733	1	30.733	98.793	0
	Within Groups	14.932	48	0.311		
	Total	**45.665**	**49**			
Cu	Between Groups	0.769	1	0.769	118.062	0
	Within Groups	0.313	48	0.007		
	Total	**1.081**	**49**			
Mn	Between Groups	98.28	1	98.28	263.309	0
	Within Groups	17.916	48	0.373		
	Total	**116.196**	**49**			
Zn	Between Groups	132.324	1	132.324	114.188	0
	Within Groups	55.624	48	1.159		
	Total	**187.948**	**49**			

One way ANOVA and discriminant provides the information about there is significant difference in micro nutrition in two studied sites but both cannot provides the information about which type of difference are there and why these difference found?

Table 4 provides the means of four micronutrition for both sites and the total also. Means provides the evidence for which type of difference are there. Closely investigation of the means revels that site 1 content low level of micro nutrition where site 2 contents in large and the difference is also very large which leads statistical significant result of ANOVA and Discriminant analysis.

Table 4: Mean

Micronutrients	Site	N	Mean
Fe	Site 1	25	1.764
	site 2	25	3.332
	Total	**50**	**2.548**
Cu	Site 1	25	0.2552
	site 2	25	0.5032
	Total	**50**	**0.3792**
Mn	Site 1	25	2.972
	site 2	25	5.776
	Total	**50**	**4.374**
Zn	Site 1	25	2.6064
	site 2	25	5.86
	Total	**50**	**4.2332**

The location of the sites played most important role in this study site 1 is far from the sea and the site 2 is very close to sea level and that is the main reason why we found the statistical significant in the analysis of micro nutrition. Saltiness of the soil played the important role in difference of micro nutrition. This difference was found for the all micro nutrition because all micro nutrition are inter correlated with each other. In order to quantify and find out relationship between micro nutrition Pearson correlation was performed.

Table 5: Correlations

		Fe	Cu	Mn	Zn
Fe	Pearson Correlation	1	.736**	.763**	.642**
	Sig. (2-tailed)		0	0	0
	N	50	50	50	50
Cu	Pearson Correlation	.736**	1	.756**	.614**
	Sig. (2-tailed)	0		0	0
	N	50	50	50	50
Mn	Pearson Correlation	.763**	.756**	1	.790**
	Sig. (2-tailed)	0	0		0
	N	50	50	50	50
Zn	Pearson Correlation	.642**	.614**	.790**	1
	Sig. (2-tailed)	0	0	0	
	N	50	50	50	50
**. Correlation is significant at the 0.01 level (2-tailed)					

The correlation between all micro nutrition found statistically significant at 1 % level of significance. The correlation is positive and moderate to high which indicate that they all vary in same direction with moderate to high intensity.

CONCLUSIONS

In this study, we used several statistical methods like discriminate analysis, ANOVA, correlation analysis and basic descriptive statistic for defining the environmental eminence of two sites in terms of soil properties like micro nutrients. From discriminate analysis, it was found that micro nutrients are fairly well discriminated and correctly classified for the two investigated sites. Through the ANOVA, it was discovered that means value of all micro nutrients (Fe, Cu, Zn and Mn) are statistically different in two sites and means provide more information as site 1 possess low micro nutrition compare to site 2. Correlation analysis provided more information on why the difference found for all

nutrients, all nutrients co-vary significantly. This study generally conclude that statistical methods can provides accurate analysis of the soil property specially micro nutrition in future the other soil property can be used for analysis for more in detail analysis.

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