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Prediction and Analysis of Soil properties in Guntur District, Andhra Pradesh

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Abstract: ***A significant statistical analysis is done over Eleven Thousand and Two hundred soil data samples of thirteen villages in Guntur District of Andhra Pradesh. Useful relationship among major soil parameters was found. An analytical approach is used to assess the properties of the soil using pandas, numpy and matplotlib libraries in python. Hidden patterns among the soil properties are identified. By using Random Forest Regressor soil data of Guntur district is predicted with considerably higher accuracy.***

Keywords **: *Soil Nutrients, Optimum fertilization rate, Yield quality, Random Forest Regressor.***

I. INTRODUCTION

Assessment of crop cultivation is exceptionally fundamental for economical creation in agribusiness. The field supplements assume pivotal job in the yield just as illness reconnaissance. The consumption of soil ripeness is one of the key reasons for decline of production profitability. The major properties of soil like calcium, pH, magnesium and manganese are reducing substantially in the soil at an alarming rate. The main objective
of soil management is to maintain the soil nutrients at a suitable level for cultivation[1]. After Green revolution, introduction of chemical fertilizers and pesticides have negatively impacted the soil. Running after higher yields resulted disadvantageous to soil and lower yield quality. It is accepted that the convergence of numerous supplements are emphatically or contrarily corresponded with major soil parameters. In the present setup we have done measurable examination to discover the shrouded examples of soil supplement relationship.Multivariate factual investigation is one of the adaptable devices in order to draw lines of similarity between various segments of soil[2].
Multivariate strategies are effectively implemented in a setup like this, for example, head segment investigation, sanctioned relationship analysis (PCA), factor analysis (FA), and authoritative correspondence examination (CCA) [3]
accounted to be proficiently used to bring out the hidden patterns among the soil nutrients.
As Doran and Perkin stated, the nature of the soil solely depends on the environmental changes and the microorganisms breeding in the soil thus supporting the biological processes in the nature. Thus ensuring the ecological balance and topsoil quality [4].
The appraisal of soil condition is essential for feasible administration of farming. Soil condition assessment involves a holistic evaluation of data samples. In checking and safeguarding the soil nutrients SQI (Soil Quality Indices) are exceptionally helpful. Evaluating and analysing different soil parameters will be a great deal of advantage in assessing the soil.
One of the most important approaches to consider is multicollinearity of soil condition. The vast majority of the examination bunches tended to this issue utilizing the multivariate factual methods, for example, head part investigation .These multivariate examinations uncovered the bury connection of soil supplement with properties, for example, saltiness of soil, cut, mud and nearness of natural issue in soil and so on. These field qualities likewise impact dispersion of vegetation, the tree attributes, for example, size, vegetation spread, thickness and so on.[5]
For the present investigation we have chosen Tenali mandal of Andhra Pradesh, which is arranged nearly the focal point of the state. The district is placed between 15°18’0’’ - 16°50’0’’N and 15°18’0’’ -16°50’0’’E. The region covers a topographical region of 410km. In the present examination we chose information from thirteen gramapanchayaths which are located in Guntur district. The yearly average downpour of the severe is 881mm.The maximum and minimum temperatures recorded are 28 and 40 degrees respectively. Guntur district is considered as an administrative capital of Andhra Pradesh. River Krishna which serves as a geographical boundary separates it with Krishna district. According to the census (2011) agricultural sector constitutes to be a leading sector providing employment to majority of people in this district.[6]
According to agricultural contingency report out of 1139 hectares of geographical area only 682 hectares is used for cultivation. The net sown area in a cropping year is 597 hectares and area sown more than once is 206 hectares. When classified on the basis of irrigation modes irrigated area is 373 hectares apart from this, 223 hectares is rainfed with a total of 79.3% of irrigated land.

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Agriculture in Guntur district is extensively dependant on crops like paddy, cotton, Maize, Black gram, red gram and few horticulture crops consisting of several fruits and vegetables.

Different assortments of vegetables are likewise developed in the region. On the other hand there is significant production of spices, aromatic, medicinal and plantation crops in the district.For the present experimental setup we have used 11,200 samples of soil data of Guntur district to work on productive analytical approach. Implementing a testing model to predict the soil data and figuring out the correlations among different properties of the soil and statistically evaluating the parameters of the soil around different villages using NumPy and Pandas libraries in python.[6]

II. LITERATURE SURVEY

a) Analysing Soil Data using Data Mining Classification Techniques - V. Rajeswari* and K. Arunesh : This gives a detail analysis on soil properties prediction and analysis using Data mining classification techniques.
b) Analysis of Soil condition Based on pH value Using Classification Techniques - Mrs. N. Hemageetha, Dr. G.M. Nasira : This research gives analysis of soil data in Salem district on the basis of pH value using Naive Bayes concept
c) Improving the prediction accuracy of soil nutrient classification by optimizing extreme learning machine parameters. – M.S Suchitra , Maya L.Pai : This gives information about prediction of village wise soil parameter aids to reduce fertilizer waste depending on the need of the crop cultivated.
d) Soil fertility evaluation of Chintayapalem village, Guntur district, Andhra Pradesh – Sumathi.P : A thesis about how soil behaves with respective to climate and soil type in different areas of Guntur District and analysing its properties.
e) A Statistical Analysis of Soil Fertility of Thrissur District, Kerala" Indian Institute of Information Technology and Management –Kerala by R.Ajith Kumar: Which is a detailed analysis of soil properties of Thrissur district of Kerala implementing ANOVA analysis.

III. SOIL FERTILITY ANALYSIS

The soil status of the region was assessed utilizing around 11,200 information focuses from various panchayaths. These examples are illustrative of different yield generation rehearses just as agro environmental zones. The present investigation depends on the mean of the examples speaking to various panchayaths exhibited in Table 1. We chose 14 distinctive panchayaths and the synopsis measurements are displayed in Table 2. The relationship investigation is appeared in Figure 1. The pH scale recommends the acidic nature of the soil in the district, ranging from at a least 6.94 to a maximum of 7.68 with a mean of 7.45 and standard deviation of 0.22. Considering these analytical results we can conclude that the soil is emphatically acidic in nature. The amount of rainfall can be accounted for such moderately lower pH values which results in reducing the base nature of the soil. Apart from these, Moisture content and temperature are also responsible for change of soil pH. [7]

Measuring electrical conductivity ensures the health and fitness of the soil with a substantial amount of salts present in it. Optimum levels of electronic conductivity ensure effective absorbance of water into soil. Sometimes it is suggested to add organic waste to increase electronic conductivity[8]. The results show that EC differs from 0.35 to 1.09 with an average of 0.55 and standard deviation 0.18. The soil EC is beneath ideal level for agribusiness in some villages of the district.

Electrical conductivity is important indicator of soil health. Excess salts can be hinder plant growth and it affects crop yield, sustainability &activity of soil microorganism .Low rainfall regions account is higher EC than regions with higher rainfall .Soil microorganism activity decreases with increases in EC.[9] Residue decomposition, nitrification, denitrification, respiration are effected by increases in EC.

The organic Carbon in the district ranges from 0.29 to 1.07 with a mean of 0.57 and standard deviation of 0.21.Where electronic carbon is an essential component for the microorganisms in the soil to grow and decompose the organic matter in the soil and provide required nutrients to the soil.[10]

Nitrogen is a major component of the chemical fertilizers used in the fields. The Nitrogen (N) value ranges from 98.79 to 317 in Guntur District resulting a mean of 229.19 with a standard deviation of 55.48.[11]All other parameters of soil are listed in Table 1 along with the statistical analysis in Table 2 with respect to different villages.

Phosphorous is assessed by using three methods soil pH , amount of organic matter and amount of phosphorous nutrients. Phosphorous constituting to be vital nutrient of the soil in Guntur district ranging from 18.13 to 59.32 with an average of 26.58.[12] Phosphorous abundance can be achieved by liming acid soils, using measures to increase organic matter.

Table1: Mean of soil parameters for selected villages from Guntur District

Panchayath	pH	EC	OC	N	P	K	S	Zn	Fe
Angalkuduru	6.94	0.35	1.07	98.79	59.32	159.82	36.8	1.63	18.25
Burripalem	7.46	0.54	0.58	201.48	28.98	382.09	41	1.62	16.55
Chinaravur	7.68	0.52	0.45	268.04	18.13	569.02	36.92	1.06	13.21
Gudivada	7.65	0.47	0.38	260.53	18.46	382.45	382.45	0.81	14.7

Katevaram	7.67	0.60	0.43	256.10	18.37	434.52	59.40	1.71	18.07
Kolakaluru	7.32	0.44	0.52	259.59	19.89	528.82	40.67	1.28	23.98
Nandivelugu	7.55	0.51	0.95	166.52	40.27	383.94	26.83	1.16	13.22
Nelapadu	7.52	0.51	0.62	212.31	23.53	446.63	52.53	1.75	20.02
Pedaravuru	7.40	0.40	0.59	211.95	34.27	660.13	35.46	1.68	10.03
Pinapadu	7.55	0.71	0.54	246.46	20.34	578.92	65.18	147.69	26.90
Sangam	7.16	0.38	0.29	317	23.73	501.17	20.08	1.32	28.53
Tenali	7.38	0.58	0.53	206.73	20.21	395.84	62.89	1.25	26.28
Tenali(U)	7.57	1.09	0.41	274.03	20.05	360.94	57.06	2.46	26.44

Table2: Statistical Analysis of soil Nutrients

	Mean	SD	Median	Min	Max	Variance
pH	7.4512	0.220534	7.525392	6.944776	7.684653	0.048635
EC	0.550496	0.189982	0.513618	0.352239	1.092152	0.036093
OC	0.570515	0.218801	0.531053	0.291778	1.075522	0.047874
N	229.1989	55.4872	246.4689	98.79104	317	3078.829
P	26.58429	11.95055	20.3445	18.13366	59.32836	142.8156
K	444.9512	126.5907	434.5227	159.8209	660.1366	16025.21
S	70.56357	94.74881	41	20.08889	382.4575	8977.337
Zn	12.72971	40.55466	1.626471	0.816644	147.6969	1644.681
Fe	19.71002	6.153336	18.25759	10.0301	28.53751	37.86354

The pH value taken into account where excess of fertilizers usage makes it more acidic effecting the plant growth. Also over usage excess of Nitrogen fertilizers effect the ground water by leaching .So there is a great need to regulate or restrict fertilizers usage.[13]

The form Nitrogen and type of Nitrogen in soil plant system in major driver for changes in soil pH value. Looking into details pH, moisture content and temperature of soil are also responsible. Monitoring Phosphates, nitrates, calcium and potassium are all primary components for plants growth. In order to check if the soil is fit or not checking EC of soil would serve the purpose required. Thus Figure 1 clearly shows us how pH is correlated to Nitrogen. As the form of Nitrogen concentration increases pH value decreases therefore increasing the acidity of soil

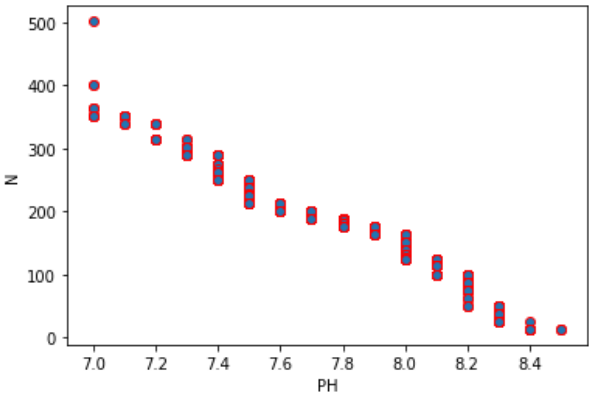

Figure1: Correlation (Relationship between pH and Nitrogen)

IV. PREDICTION REPORT

The prediction of soil properties is implemented using Random Forest Regressor in spyder IDE where we achieved 89% accuracy rate with a loss of 0.02 which is considered to be least. These prediction analysis findings are reported in the Table 3 below. As a future improvement we are planning to map the set crops with the results obtained after prediction and give an optimum result for relevant crop to be cultivated with respect to the soil requirements.

Table 3: PREDICTION ANALYSIS REPORT

RMSE	ExpVar	MAE	MSE	MSLE	MedAE	RMS log error	R*R
0.211	0.886	0.083	0.046	0.001	0.013	0.35	0.886
0.211	0.886	0.083	0.046	0.001	0.013	0.35	0.886
0.214	0.885	0.081	0.046	0.001	0.013	0.36	0.885
0.214	0.885	0.081	0.046	0.001	0.013	0.36	0.885

*RMSE =root mean square error *MAE=Mean Absolute Error *MSE=Mean Squared Error *ExpVar=Exp_Variance *MSLE=Mean Squared Log Error *MedAE=Median Absolute Error

V. CONCLUSION

Assessing the soil properties using data samples of Guntur District was performed using python in spyder IDE. The datasets are collected from 13 different panchayats in two different Cultivation years. The Analysis shows that there is a significant correlation between pH and Nitrogen parameters. A detailed Statistical Analysis is done on soil properties like pH, EC, OC, N, P, K,Fe,Zn.Apart from these an efficient predicting algorithm Random Forest Regressor is used to predict the soil properties.

REFERENCE

1. P. Rajasekharan, K. M. Nair, G. Rajasree, P. Suresh kumar, M. C. Narayanan Kutty, Eds. Soil Fertility Assessment and Information Management for Enhancing Crop Productivity in Kerala. Kerala State Planning Board, 2013.
2. A. O. Aweto, "Secondary Succession and Soil Fertility Restoration in South-Western Nigeria: III. Soil and Vegetation Interrelationships" Journal of Ecology, vol. 69, pp. 957-963, Nov., 1981.
3. A I Iwara,; F O Ogundele, U W Ibor, T N. Deekor, "Multivariate Analysis of Soil-Vegetation Interrelationships in a South-Southern Secondary Forest of Nigeria" International Journal of Biology vol. 3, pp. 73-82, 2011.
4. Doran JW, Parkin TB "Defining and assessing soil quality" in Doran JW, Coleman DC, Bezdicek DF, Stewart BA, editors. Defining Soil Quality for a Sustainable Environment. Madison: Soil Sci Soc Stet Am. pp. 3–21, 1994.
5. S. Sridevi*, M.Bindu Prathyusha, P.V.S.J.Krishna Teja ," User behavior analysis on agriculture mining system".
6. Siri Sumana Kalavala, Sridevi Sakhamuri, B B V Satya Vara Prasad ,"An Efficient Classification Model for Plant Disease Detection".May,2019,pp 126-129
7. Gopi Krishna P., Ravi K .S., Nishanth C., Chowdary K.K.,reddyKU
8. Sridevi, S., Aruna Sri, P.S.G., Prema Sindhuri, B. "Indian ontology based feature extraction technique for effective document clustering in agricultural Domain,"Journal of Advanced research in Dynamics and Control Systems,2018,pp529-533
9. DMAH P Vinay Kumar."Soil nutrient measurement in Paddy farming Using IoT"
10. DMAH Moulana, "A frame work for efficient decision Tree using attribute Elimation and dual processing techniques".
11. RB Badu , MA Hussain , RB babu , "Comparitive study of Algorithm on class imbalanced Datasets"
12. G.V.SaiPrassana,G.Vijay Kumar,"Controlling and Monitoring plant growth conditions using Embedded systems
13. Balram G, Kiran Kumar K ,"Smart farming: Disease detection in crops".