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Environmental Science

SPATIAL VARIABILITY MAPPING OF MACRONUTRIENTS ACROSS AMRELI AND KACHCHH DISTRICT, GUJARAT

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ABSTRACT In the era of modern Indian agriculture macronutrients are important nutrient elements for growth and productivity of the crops. Soil macronutrients datasets of Amreli (265 samples) and Kachchh district (144 samples) were obtained in spreadsheet format from Anand Agriculture University, Gujarat. Further, generated spatial distribution maps of macronutrients (viz. phosphorus, potassium and sulphur) using IDW interpolation technique of GIS. Range and average variability status also estimated using Exploratory Spatial Data Analysis tool of ArcGIS10. Soil Nutrients Indices evaluate fertility class of soil. The results of SNI revealed low fertility class of phosphorus and sulphur across Amreli district while across Kachchh district SNI revealed medium fertility class of phosphorus & sulphur. Across Amreli district SNI revealed medium fertility class of available potassium while Across Kachchh district SNI revealed higher fertility class of available potassium. On the basis of spatial distribution maps and SNI recommended fertilizer doses for nutrients management.

KEYWORDS : Geographic Information System (GIS), Inverse Distance Weighting (IDW), Soil Nutrients Indices (SNI), Spatial Distribution

INTRODUCTION

Soil is a natural medium for crop production and plant growth. It provides essential nutrients to plant for normal growth and stability. Plant growth is determined through soil fertility and soil fertility is determined by the availability of macronutrients (Patel, 2014). It has been estimated that about 50% of the increment in agricultural production of the world has been possible due to improved soil fertility management through mineral fertilizers (Stewart *et al.,* 2005).Under this context, GIS based soil fertility mapping can provide a cost effective alternative strategy for an effective nutrient management practice (Patil *et al.,* 2010). An IDW method of interpolation creates continuous surface maps for each parameter allowing estimation of soil properties for un-sampled points within the study area (Sen *et al.,* 2008). GIS based soil fertility mapping is emerging as a promising technology for assessing spatial variability of soils and preparing soil fertility maps for fertilizer recommendation with lesser numbers of soil analysis (Patil *et al.,* 2010; Sen *et al.,* 2008). The objectives of the study were to generate spatial distribution maps of soil nutrients, to evaluate fertility class of soil for enhancing crop productivity across Amreli and Kachchh district of Gujarat state, India.

STUDY AREA

For spatial variability mapping of soil macronutrients as a study area selected Amreli district from Saurashtra Zone and Kachchh district from Kachchh zone of Gujarat state, India.

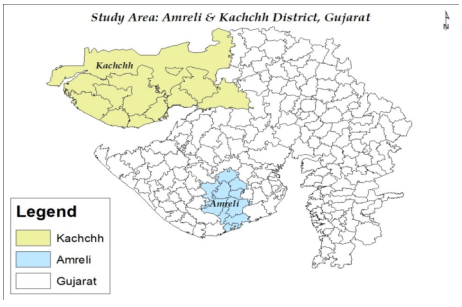

Fig.1: Location map of study area

METHODOLOGY

For the present study analyzed soil nutrients datasets of Amreli (265 samples) and Kachchh district (144 samples) were obtained in spreadsheet format from Anand Agriculture University, Gujarat Entire work programme was broadly grouped into two phases. During the first phase of the work, prepare proper data sets to import and visualize into ArcGIS10. Using Inverse Distance Weighting (IDW) interpolation method further generated spatial distribution maps of soil macronutrients for effective nutrient management. During the second phase of work programme geo-statistical analysis were carried out through Exploratory Spatial Data Analysis (ESDA) tool which displays the summary statistics (range and mean value) of available soil nutrients. Also to evaluate fertility class of soil across study area calculated Soil Nutrients Indices using following formula

Nutrient Index= {(NL*1)+(NM*2)+(NH*3)}/TNS

Where,
NL = Number of samples in low category
NM = Number of samples in medium category
NH = Number of samples in high category
TNS = Total number of samples

For classification of soil nutrients datasets into low, medium and high category is based on following ratings.

Ratings	Macronutrients		
	P (kg/ha)	**K (kg/ha)**	**S (ppm)**
Low	<28	<140	<10
Medium	28-56	140-280	10-20
High	>56	>280	>20

(Table-1: Ratings for classification of soil macronutrients values)

A SNI value less than 1.67, between 1.67 to 2.33 and more than 2.33 indicates low, medium and high fertility status of soil, respectively.

RESULTS AND DISCUSSION

Available phosphorus:

Available phosphorus of investigated soils across Amreli district varied from 2 – 148 kg ha-1 with mean value of 37 kg ha-1 and soil nutrient index value was 1.65 revealed low fertility class of soil while across Kachchh district available phosphorus varied from 10 – 98 kg ha-1 with mean value of 35 kg ha-1 and SNI value was 1.73 revealed medium fertility class of soil. Spatial variability maps of available phosphorus status across the soil of Amreli and Kachchh district are shown in figure 2 and 3.

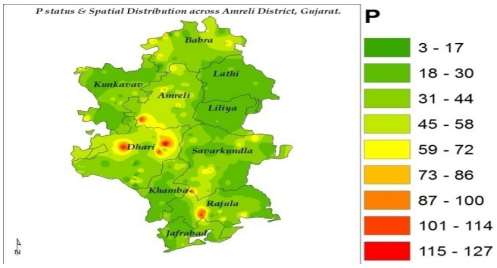

Fig.2: Available phosphorus status and spatial distribution across Amreli district, Gujarat.

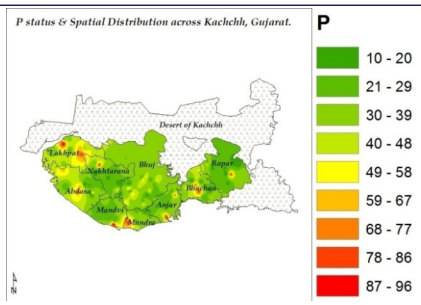

Fig.3: Available phosphorus status and spatial distribution across Kachchh district, Gujarat.

Recommendation: Across Amreli district SNI revealed low fertility class of available phosphorus so, it is recommended to give 25 to 30% more fertilizer while across Kachchh district available phosphorus was medium so, it is recommended to apply appropriate fertilizer according to type of soil and required level of P contain fertilizer.

Available potassium:

Available potassium of investigated soils across Amreli district varied from 43 – 715 kg ha^{-1} with mean value of 195 kg ha^{-1} and soil nutrient index value was 1.83 revealed medium fertility class of soil while across Kachchh district available potassium varied from 58 – 1056 kg ha^{-1} with mean value of 353 kg ha^{-1} and SNI value was 2.44 revealed higher fertility class of soil. Spatial variability maps of available potassium status across the soil of Amreli and Kachchh district are shown in figure 4 and 5.

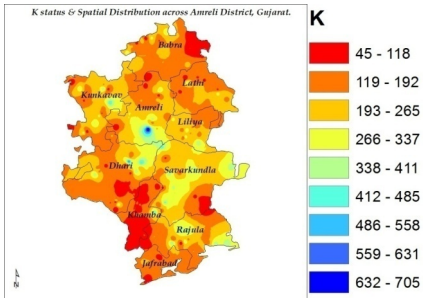

Fig.4: Available potassium status and spatial distribution across Amreli district, Gujarat.

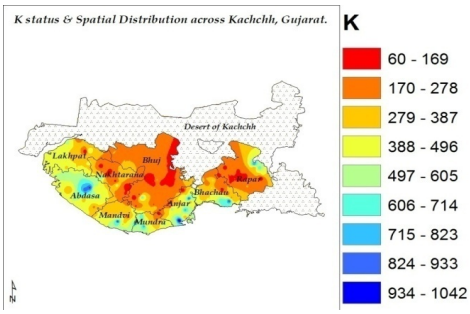

Fig.5: Available potassium status and spatial distribution across Kachchh district, Gujarat.

Recommendation: Across Kachchh district SNI revealed higher fertility class of available potassium. so, it is recommended to give 15 to 20% less fertilizer than a required level of K contains fertilizers while across Amreli district available K revealed optimum fertility class. So, it is recommended to apply appropriate fertilizer according to type of soil and required level of K contain fertilizer.

Available sulphur:

Available sulphur of investigated soils across Amreli district varied from 1 – 92 ppm with mean value of 13 ppm and soil nutrient index value was 1.53 revealed low fertility class of soil while across Kachchh district available sulphur varied from 3 – 181 ppm with mean value of 37 ppm and SNI value was 2.31 revealed medium fertility class of soil. Spatial variability maps of available sulphur status across the soil of Amreli and Kachchh district are shown in figure 6 and 7.

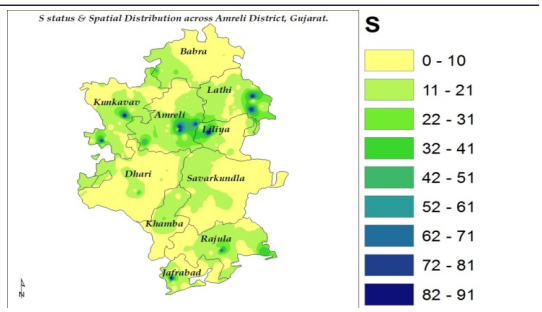

Fig.6: Available sulphur status and spatial distribution across Amreli district, Gujarat.

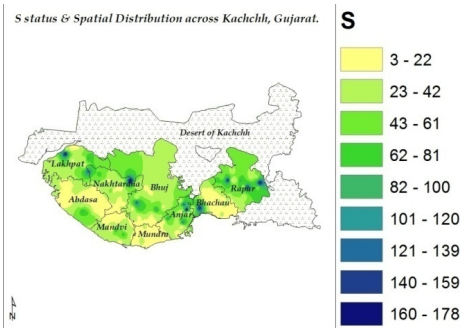

Fig.7: Available sulphur status and spatial distribution across Kachchh district, Gujarat.

Recommendation: SNI revealed low and medium fertility class of soil across Amreli and Kachchh district, respectively. So, it is recommended to mix 500 kg ha^{-1} gypsum in the soil or use sulphur contains fertilizer like sulphate or ammonium sulphate.

CONCLUSIONS

It can be concluded that the spatial maps generated under the study will be useful for guiding the farmers to decide the amount and kind of macronutrients to be applied for economic returns based on site specific nutrient management Geo-statistical analysis estimates range and average variability status of available nutrients while Soil nutrient indices evaluate fertility class of soil. Both, Geo-statistical analysis and SNI helps in better understanding of macronutrients management.

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REFERENCES

[1] Denis Magnus, Ken Amara, Parameshgouda L. Patil, Augustine M. Kamara and Daniel H. Saidu. (February, 2017). Assessment of soil fertility status using nutrient index approach *Academia Journal of Agricultural Research* 5(2): 028-038, February 2017

[2] Kanubhai P. Patel, Swanti A. Jain, Bhanuben K. Patel, Manoj S. Jagtap and (2014). Analysis of phosphorus in soil of Lunawada taluka dist: Panchamahal, Gujarat. Scholars research library. *Archives of Applied Science Research,* 2014, 6 (1):67-72

[3] M. Vijaya Kumar, Bakiyathu Saliha, B., Kannan, P. and Mahendran P. (2015). Delineation and geographic information system (GIS) mapping of soil nutrient status of sugarcane growing tracts of Theni district, Tamil Nadu.

[4] Patil S.V., Sing.S.R. and Maji.A.K. (2010) A GIS-based land use suitability assessment in Seoni district, Madhya Pradesh, India. *Tropical Ecology,* 51(1):41-54.

[5] Prakash L. Patel, Anita Gharekhan, Nirmal P. Patel & Prakash H. Patel (2014), Study of Micronutrients through Statistical Data Treatment of Agricultural Soil of Bhuj and Mandvi Sites in Kutch District. *International Journal of Research in Applied, Natural and Social Sciences,* Vol. 2, Issue 6, Jun 2014, 135-142.

[6] Sen, P., Majumdar.K. and Sulewski.G. (2008), Importance of spatial nutrient variability mappingtofacilitate SSNM in small land holding systems.*Indian J. Fert.*4 (11):43-50. *African Journal of Agricultural Research* Vol. 10(33), 2015, pp. 3281-3291.

[7] Stewart W.M., Dibb.D.W., Johnston.A.E. and Smith T.J. (2005), The contribution of commercial fertilizer nutrients to food production. *Agron. J.* 97:1-6.