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# Delineation of Management Zones in Citrus Orchards Using Geostatistics and Clustering Techniques in Central India


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## INTRODUCTION & AIM

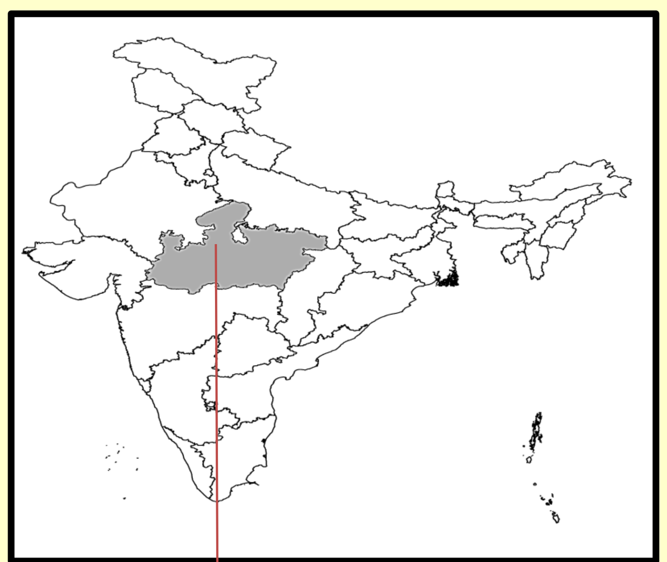
**Soil nutrient management in citrus orchards across central India still largely follows traditional, uniform guidelines that overlook the spatial variability of environmental conditions so that unbalanced blanket fertilization, inconsistent yields, and reduced fruit quality, ultimately affecting farmers' profitability.**

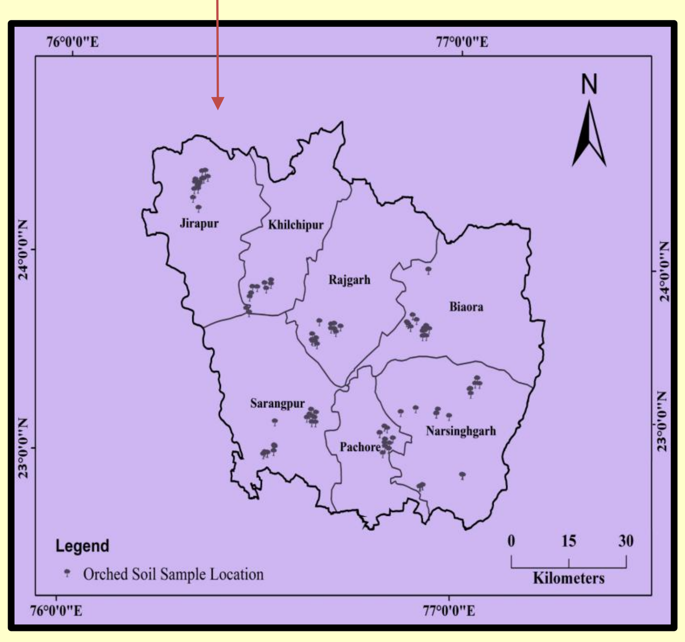

**Low yield citrus orchards In the Malwa Plateau in central India**

**This study aimed to assess the spatial variability of soil properties in citrus orchards on the Malwa Plateau in central India using geostatistical techniques and to delineate potential management zones through principal component analysis and fuzzy c-means clustering.**

## METHOD

**Study area in central India**






**Methodology adopted**

1. Preliminary survey of citrus orchards in Region
2. Soil sample collection (0-0.2m depth) from periphery of tree trunk at 1.25 m away
3. Soil nutrient chemical analysis as per standard protocol mentioned by FAO(2008)
4. PCA and Fuzzy clustering followed by Delineation of management zone and mapping using ordinary kriging
5. Site specific management in existing orchards and potential areas

**Optimal number of management zone (MZ) determined using the fuzziness performance index (FPI) and normalized classification entropy (NCE).**

## RESULTS & DISCUSSION

**Table : Mean values of soil properties in different management zones**

| Management zone | pH | EC (dS/m) | SOC% | N (kg/ha) | P (kg/ha) | K (kg/ha) | Ex.Ca (ppm) | Ex.Mg (ppm) |
|---|---|---|---|---|---|---|---|---|
| 1 | 7.38a | 0.15a | 0.49a | 185.40a | 44.18c | 481.98b | 2250.07a | 1376.36b |
| 2 | 7.75b | 0.21b | 0.52a | 179.55a | 34.72b | 524.20b | 2755.06b | 992.62a |
| 3 | 7.94c | 0.17a | 0.45a | 192.10a | 21.07a | 442.93a | 3098.94b | 858.20a |

| Management zone | S (ppm) | Zn (ppm) | Cu (ppm) | Mn (ppm) | Fe (ppm) | B (ppm) | Area % |
|---|---|---|---|---|---|---|---|
| 1 | 17.86b | 0.95b | 1.13b | 19.42c | 25.44c | 0.74a | 3.0 |
| 2 | 18.46b | 1.50c | 1.61c | 11.21b | 15.94b | 0.75a | 46.3 |
| 3 | 13.68a | 0.64a | 0.81a | 8.09a | 13.23a | 0.75a | 50.7 |

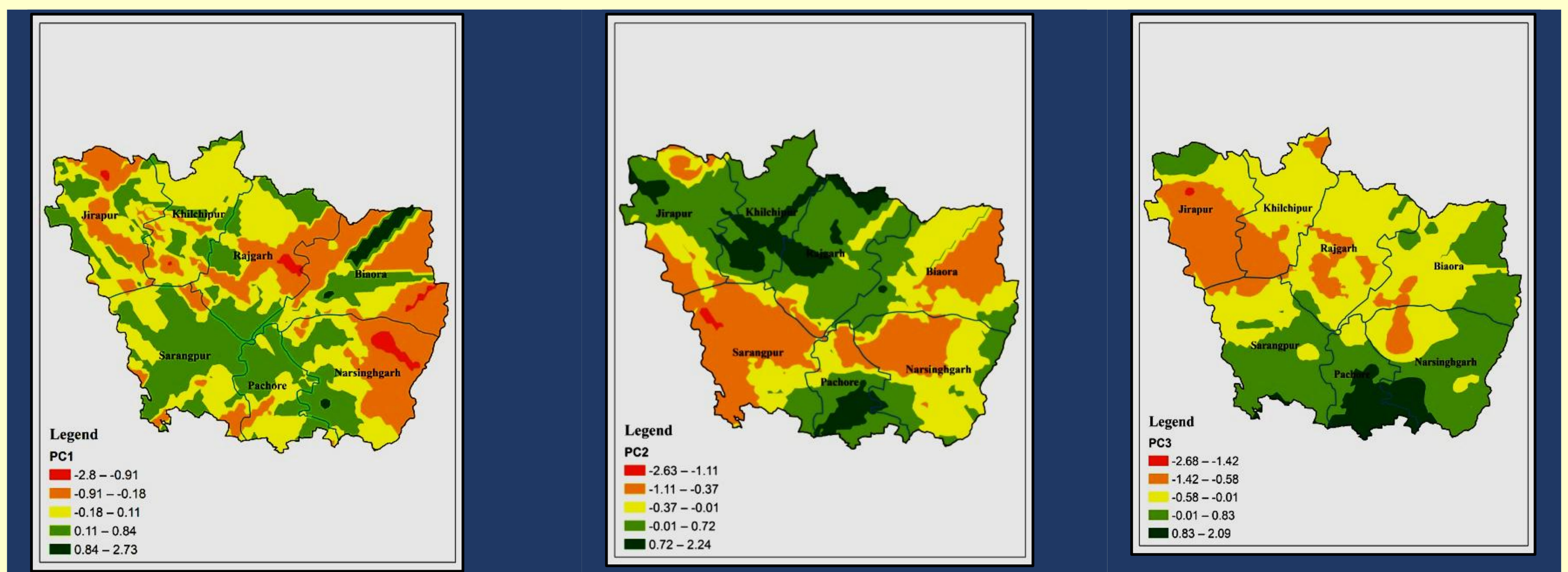



Fig: Kriged map of three project components

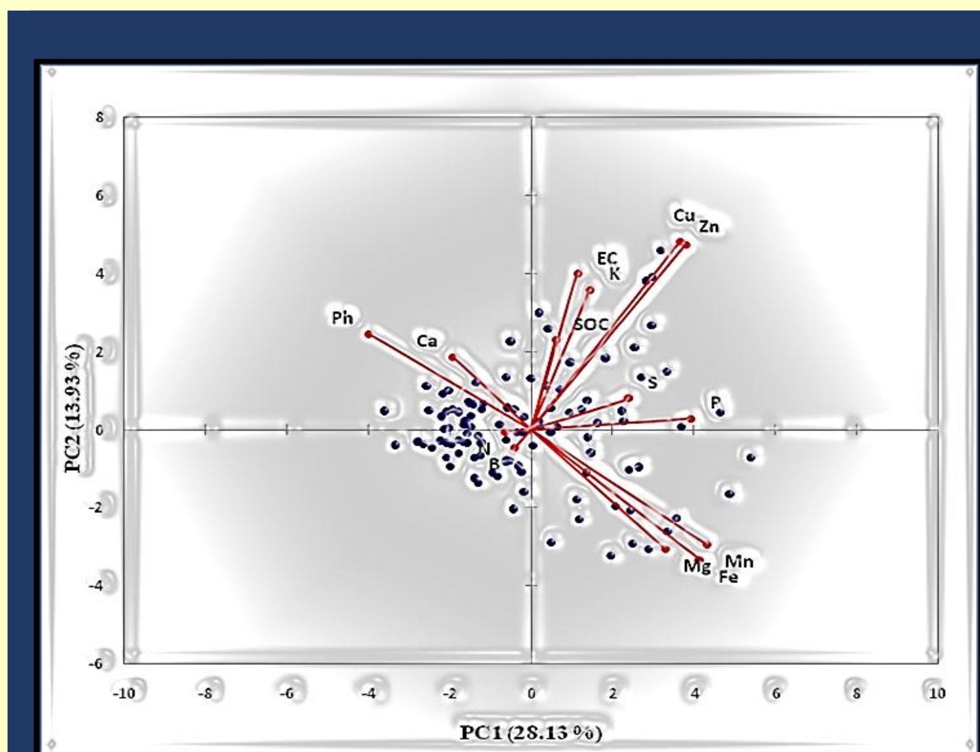



Fig:Biplot analysis

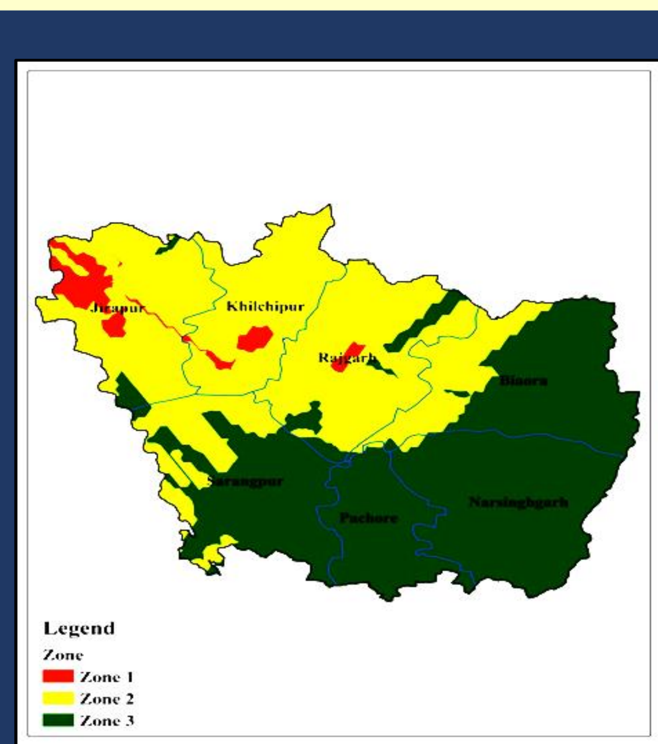



Fig:Delineated Management zone

- **Efforts must be done to improve available nitrogen in MZ 1and MZ2 that were having lower nitrogen in comparisons with MZ 3 .SOC content by different agricultural practices in MZ 3 which is having lowest SOC content among the MZs.**
- **Average values of soil parameters in each zone can serve as benchmarks for site-specific nutrient management, thereby optimizing crop yields and minimizing input costs.**

## CONCLUSION

**Preliminary zone-specific nutrient management guidelines were developed based on these delineated zones, suggesting differentiated fertilizer rates and organic matter inputs tailored to each zone's fertility status .The developed recommendations system optimize nutrient application and use efficiency precisely**

## FUTURE WORK

- **Integrating Diagnosis and Recommendation Integrated System (DRIS) and developed nutrient management zone ,the validity is better in comparison to blanket fertilizer recommended which further improves fruit yield and quality, and provide practical decision-support tools for farmers and extension services.**
- **The broader adoption of precision agriculture in central India, contributing to more sustainable and resilient citrus production systems and in other fruit crops of the region.**

## REFERENCES


Motsara, M. R., & Roy, R. N. (2008). *Guide to laboratory establishment for plant nutrient analysis* (Vol. 19, pp. 101-122). Rome: Food and Agriculture Organization of the United Nations.