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## Spatial soil status of exchangeable Ca, Mg and Na under different land use systems of district Doda, J&K

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**Abstract**

To assess the spatial exchangeable nutrient status (Ca, Mg and Na), a soil survey was conducted at district Doda, J&K. Composite surface soil samples were collected randomly from different land use systems viz; Forest, Horticulture at a depth of (1 metre), Barren Lands and Agriculture at a depth of (0-15cm). The exchangeable calcium recorded was higher under barren lands (2.15-6.18 meq100g<sup>-1</sup>) followed by horticulture, forest and agriculture land uses. The exchangeable Magnesium of the soils under different land use systems recorded was higher under barren lands (0.57-1.75 meq100g<sup>-1</sup>) followed by horticulture, forest and agriculture land uses. The exchangeable sodium range recorded was higher under barren lands (15.69-97.56 mg Kg<sup>-1</sup>) followed by forest, horticulture and agriculture, respectively. Exchangeable calcium was low (<2.5 meq100g<sup>-1</sup>) in northern area of block Ghat. Calcium was medium (<2.5-5.0 meq100g<sup>-1</sup>) in major portions of the district. Exchangeable magnesium was low (<0.75 meq100g<sup>-1</sup>) in north-eastern areas of Ghat and major portions of Gandoh block towards northern and southern side. Magnesium was medium (0.75-1.50 meq100g<sup>-1</sup>) in major portions of the district. Exchangeable sodium was medium (50-100 mgKg<sup>-1</sup>) in major portions of district. Sodium was low (<50 mgKg<sup>-1</sup>) in Northern area of Bhaderwah block, respectively.

**Keywords:** Exchangeable nutrient, land use, barren land, composite, survey

**Introduction**

Soil plays a vital role in determining the sustainable productivity of an agro-ecosystem. Soil testing provides information regarding nutrient availability in soils which forms the basis for the fertilizer recommendation for maximizing crop yields. Soil fertility maps are meant for highlighting the nutrient needs, based on fertility status of soils (and adverse soil conditions which need improvement) to realize good crop yields. Several authors have indicated that the availability of nutrients in soils depends on soil pH, organic matter content, adsorptive surfaces and other physical, chemical and biological conditions in the rhizosphere (Kabata Pendias, 2001, Yadav, 2011) [4, 3]. The advent of information technology have provided tools like Global Positioning System (GPS), Geographical Information System (GIS) which helps in collecting a systematic set of geo-referenced samples and generating the spatial data about the distribution of nutrients (Sharma 2004; Palaniswami *et al.*, 2011) [7, 1]. The Inventory of the nutrient status of the soils help in demarcating areas where the application of particular nutrient is needed for profitable crop production (Sood *et al.*, 2009) [2].

**Material and Methods**

The area lies in pir panjal range or middle Himalayas having subtropical to temperate climate. It lies between 32°53' N to 34°21' N latitude and 75°47' to 76°47' E longitude with an average elevation of 1107 m from mean sea level. The average annual humidity is 68%. The average annual rainfall recorded is 75cms. The topography of this area is rugged with lot of forests. Composite surface soil samples were collected at a depth of 0-15cm from agriculture and barren lands and at a depth of 1 metre from forests and horticulture land uses, distributed randomly across whole of the district. The samples were air dried, ground in a pestle-mortar

and passed through a 2mm stainless sieve for determining exchangeable Ca, Mg and Na status. The nutrients were analyzed using ammonium acetate extract through EDTA method. The exact sample location will be recorded using a handheld GPS receiver.

## Result and Discussion

### Exchangeable Calcium

The exchangeable calcium ranged from 1.23-4.17 m eq/100g under forest, 2.15-6.18 m eq/100g under barren land, 0.44-

2.96 m eq/100g under agriculture and 1.15-5.12 m eq/100g under horticulture (Table-1). The mean value, standard error of mean, standard deviation, skewness and kurtosis was 2.41, 0.12, 0.85, 0.34 and -1.18 under forest, 4.18, 0.33, 1.39, 0.12 and -0.93 under barren land, 1.65, 0.08, 0.56, -0.29 and -0.02 under agriculture and 2.71, 0.25, 1.41, 0.54 and -1.29 under horticulture respectively. Exchangeable calcium was low (< 2.5 m eq/100g) in northern area of block Ghat. Calcium was medium (< 2.5-5.0 m eq/100g) in major portions of the district as depicted in (Figure 1).

**Table 1:** Descriptive statistics of Exchangeable Calcium (m eq 100g<sup>-1</sup>) under different land use systems

| Exch Ca        | Type of Land use Systems |             |             |              |
|----------------|--------------------------|-------------|-------------|--------------|
|                | Forest                   | Barren land | Agriculture | Horticulture |
| Minimum        | 1.23                     | 2.15        | 0.44        | 1.15         |
| Maximum        | 4.17                     | 6.81        | 2.96        | 5.12         |
| Mean           | 2.41                     | 4.18        | 1.65        | 2.71         |
| ±S.E(Mean)     | 0.12                     | 0.33        | 0.08        | 0.25         |
| Std. Deviation | 0.85                     | 1.39        | 0.56        | 1.41         |
| Skewness       | 0.34                     | 0.12        | -0.29       | 0.54         |
| Kurtosis       | -1.18                    | -0.93       | -0.02       | -1.29        |

### Exchangeable Magnesium

The exchangeable Magnesium of the soils under different land use systems ranged from 0.15-1.45 m eq/100g under forest, 0.57-1.75 m eq/100g under barren land, 0.11-0.98 m eq/100g under agriculture and 0.19-1.46 m eq/100g under horticulture (Table-2). The mean value, standard error of mean, standard deviation, skewness and kurtosis was 0.75, 0.05, 0.33, 1.13 and -0.27 under forest, 1.18, 0.09, 0.40, -0.09

and -1.11 under barren land, 0.48, 0.03, 0.19, 0.02 and -0.02 under agriculture and 0.66, 0.07, 0.40, 1.01 and -0.48 under horticulture respectively. Exchangeable magnesium was low (<0.75 m eq/100g) in north-eastern areas of Ghat and major portions of Gandoh block towards northern and southern side. Magnesium was medium (0.75-1.50 m eq /100g) in major portions of the district as depicted in (Figure 2).

**Table 2:** Descriptive statistics of Exchangeable Magnesium (m eq 100g<sup>-1</sup>) under different land use systems

| Exch Mg        | Type of Land use Systems |             |             |              |
|----------------|--------------------------|-------------|-------------|--------------|
|                | Forest                   | Barren land | Agriculture | Horticulture |
| Minimum        | 0.15                     | 0.57        | 0.11        | 0.19         |
| Maximum        | 1.45                     | 1.75        | 0.98        | 1.46         |
| Mean           | 0.75                     | 1.18        | 0.48        | 0.66         |
| ±S.E(Mean)     | 0.05                     | 0.09        | 0.03        | 0.07         |
| Std. Deviation | 0.33                     | 0.40        | 0.19        | 0.40         |
| Skewness       | 1.13                     | -0.09       | 0.02        | 1.01         |
| Kurtosis       | -0.27                    | -1.11       | -0.02       | -0.48        |

### Exchangeable Sodium

The exchangeable sodium ranged from 28.36-92.12 mg/Kg under forest, 15.69-97.56 mg/Kg under barren land, 14.58-89.27 mg/Kg under agriculture and 13.60-91.64 mg/Kg under horticulture (Table-3). The mean value, standard error of mean, standard deviation, skewness and kurtosis was 56.28, 2.08, 14.84, 0.59 and -0.30 under forest, 59.98, 4.84, 17.28, -0.68 and 0.50 under barren land, 53.58, 2.58, 18.09, 0.01 and -0.62 under agriculture and 49.92, 2.75, 19.23, 0.14 and -0.60 under horticulture respectively. Exchangeable sodium was medium (50-100 mg / Kg) in major portions of district. Sodium was low (<50 mg / Kg) in Northern area of Bhadrawah block as depicted in (Figure 3)

Exchangeable sodium (Na), calcium (Ca) and magnesium (Mg) contents were observed higher in the barren lands than other land use system which was associated with high pH in this land use and was in agreement with similar findings as reported by Deressa, (2013) [5]. Similarly, low level of Ca and Mg in cultivated land might be due to crop removal, low holding by OM, use of acid forming fertilizers like urea in clay and clay loam soils for rice cultivation and due to leaching of these cations, while as higher level of Ca, Mg in

barren lands are due to the higher pH of barren lands by dominance of calcification process. The results are similar with the studies of Gebrelibanos and Assen, (2013) [6].

**Table 3:** Descriptive statistics of Exchangeable Sodium (mg kg<sup>-1</sup>) under different land use systems

| Exch Na        | Type of Land use Systems |             |             |              |
|----------------|--------------------------|-------------|-------------|--------------|
|                | Forest                   | Barren land | Agriculture | Horticulture |
| Mean           | 28.36                    | 15.69       | 14.58       | 13.60        |
| Minimum        | 92.12                    | 97.56       | 89.27       | 91.64        |
| Maximum        | 56.28                    | 59.98       | 53.58       | 49.92        |
| ±S.E(Mean)     | 2.08                     | 4.84        | 2.58        | 2.75         |
| Std. Deviation | 14.84                    | 17.28       | 18.09       | 19.23        |
| Skewness       | 0.59                     | -0.68       | 0.00        | 0.14         |
| Kurtosis       | -0.30                    | 0.50        | -0.62       | -0.60        |

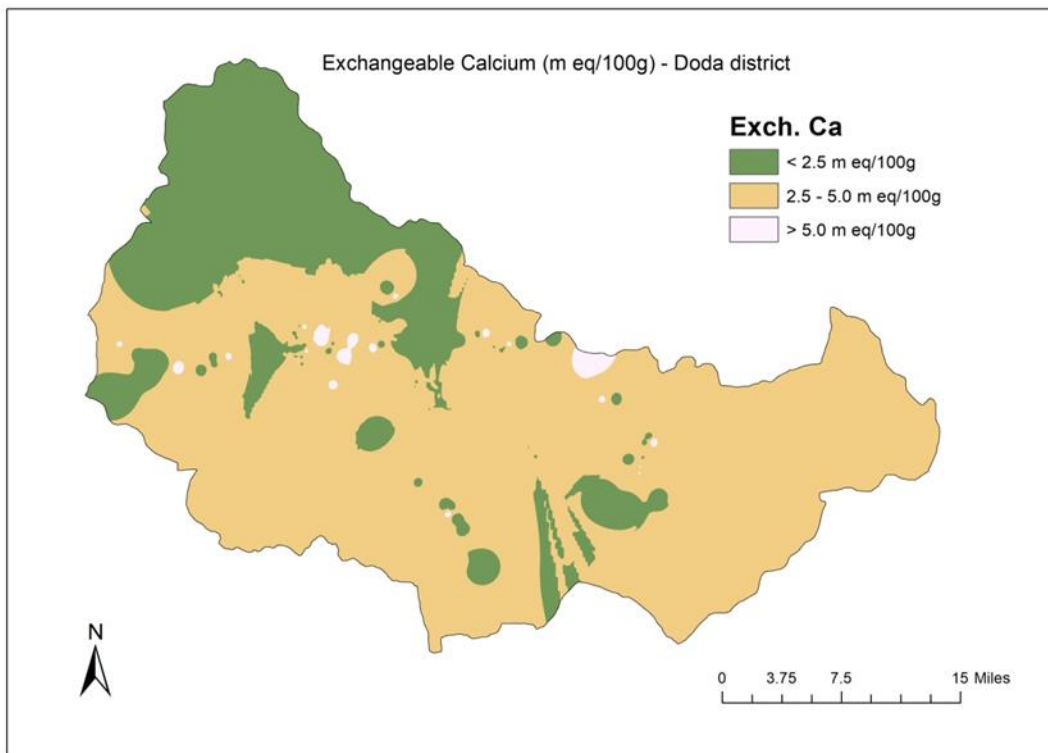
## Conclusion

The exchangeable nutrients ranged between low to medium from majority of areas. So these Spatial Soil fertility maps at district level will benefit the farmers and planners alike and will help in taking location specific dimensions on nutrient management and soil health.

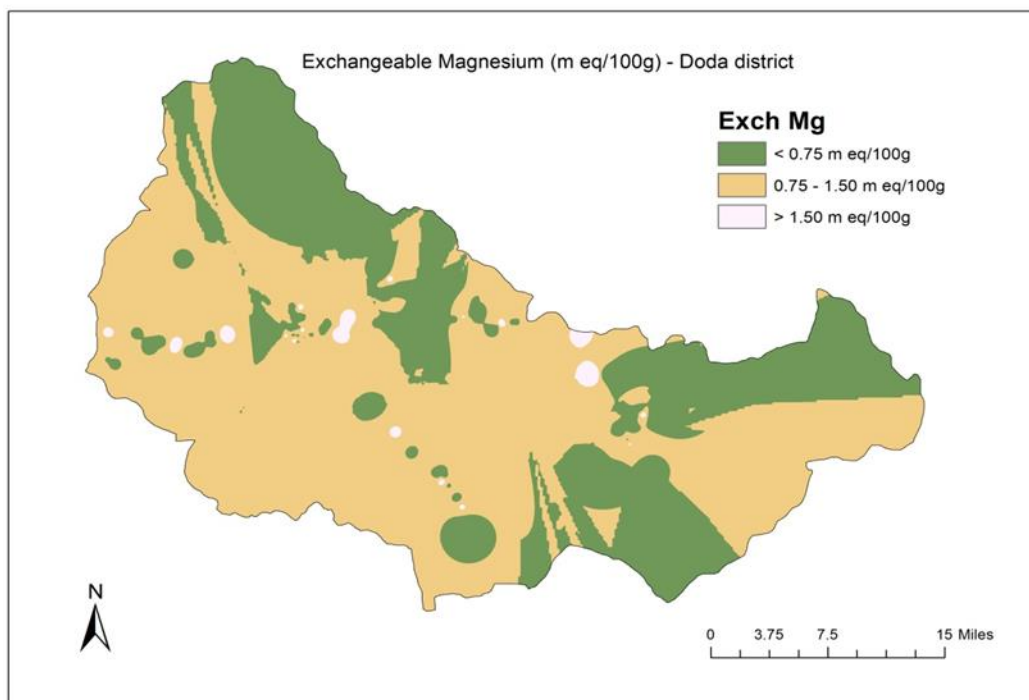
**Spatial soil fertility maps of exchangeable nutrients of Doda district**

The geographical information system software Arc GIS were used to interpolate the results from the point data to the entire region. The extent of area in low, medium and high category

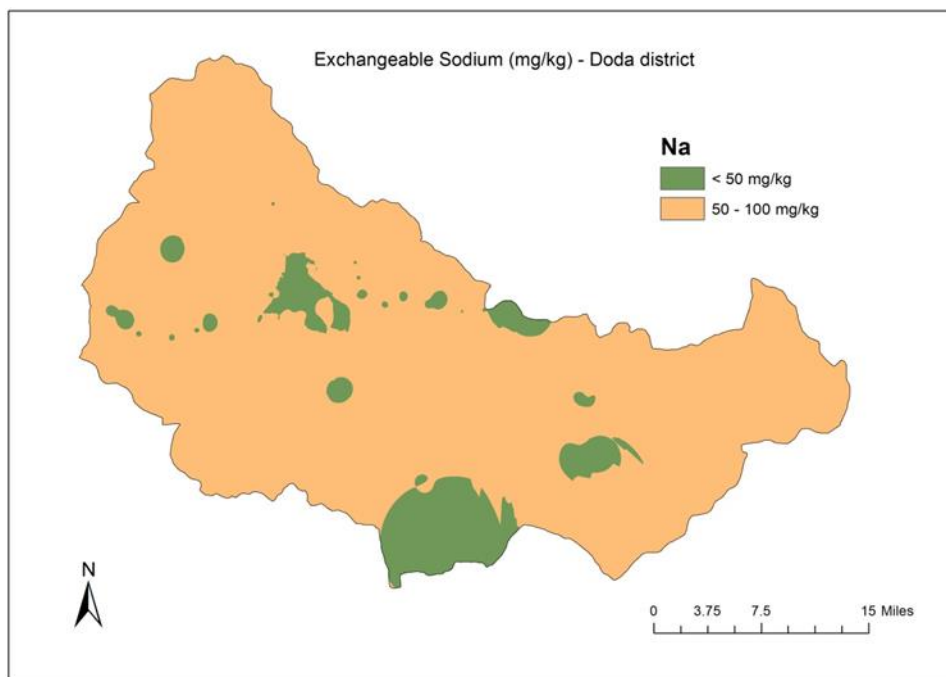
of nutrients was estimated on the basis of standard ratings. Maps concerning the distribution of nutrient elements and physico-chemical properties were generated by using Geographic Information System and Inverse distance weighting (IDW) technique



**Fig 1:** Map of exchangeable calcium in soils of Doda District



**Fig 2:** Map of exchangeable Magnesium in soils of Doda District



**Fig 3:** Map of exchangeable Sodium in soils of Doda District

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