



ISSN NO. 2320-5407

Journal homepage: <http://www.journalijar.com>

INTERNATIONAL JOURNAL
OF ADVANCED RESEARCH

RESEARCH ARTICLE

Macronutrient Status in Soils of South Kashmir Himalayas, J&K-INDIA

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Manuscript Info

Manuscript History:

Received: 11 January 2015

Final Accepted: 22 February 2015

Published Online: March 2015

Key words:

Soil fertility; Macronutrient;
Nutrient Index; Nitrogen-
Phosphorous-Potassium (NPK),
Altitudinal Zone; Karewa, South-
Kashmir

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Abstract

The present study is an attempt to assess macronutrient (N, P, and K) status in soils of south Kashmir Himalayas by calculating nutrition Index (NI). The study is based on 280 soil samples (90 composite samples), collected at a depth of 0-100 cm at 30 sampling sites across different altitudinal zones. Based on results, the whole study area was delineated into different fertility zone based on nutrition index rating both at surface and sub-surface zones. It was found that macronutrient status in terms of NPK decreases with altitude mainly due to geophysical constraints like slope as low nutrient index 1.5-2.5 was found at above 20° as compared to more than 3 in zone I with 5° to 10° slope. The study shall be of great significance not only in understanding the agricultural resource base of the region but will also provide a new strategy to curb malnutrition which is prevalent in the area and will develop focus for its optimum use.

INTRODUCTION

Soil acts as an engineering medium (Ritter, 2006) with tremendous range of available niches and habitats; contains most of the earth's genetic diversity (Hodges, 2010). It is composed of both macro and micro nutrients which are critically important component of earth's biosphere hence, plays an important role in the maintenance of biodiversity and habitat (County, 2014). It controls fertility of the soils, yields and growth of plant (Kathrin 2010, Verma et al. 2011). The characteristics of soils differ widely depending upon the geophysical constraints like nature of the rock; climate and topography soil pH and the susceptibility of the soil to compaction are dependent on the constituents of the original parent rock (Brady, 1984). Soil fertility is determined by the presence or absence of nutrients i.e. macro and micronutrients. that are not uniformly found in the soils (Wajahat et al, 2006) leading some soils surplus and other deficit in terms of concentration. These nutrients are essential for the life cycle of normal growth of plants, deficiency of which can be corrected by supplying the elements (Kolley, 1993). Nutrients are available as ions in three forms i.e. ions held as colloidal particles, ions absorbed on colloidal surface and ions in solution form (Kanth and Rather, 2003). Of these three forms, those in solution form are the most readily available to plants (David, 1977). Nutrients are continuously removed from the soils by cropping (Young, 1976) in addition to losses by runoff (Kirby and Morgan, 1980) and even a high fertile soil is exhausted of reserve nutrients, as the crops

Material and Method:

This study was designed to determine the status of macronutrients in agriculturally fertile soils of South Kashmir Himalayas. The study area was delineated into five altitudinal zones ranging from 1750 to 2500 (fig.1) showing 30 sites that were selected for the study across different altitudes. Represented soil samples were collected with wooden tools to avoid any contamination of the soils. Three to five pits were dug for each sample. From each pit sample was collected at a depth 0-30cm. A composite sample of about 1kg was taken through mixing of represented soil sample. All composite samples were dried, ground with wooden mottle and passed through 2mm sieve. After sieving all the samples were packed in the labeled polythene bags for laboratory investigations. Of the six macro nutrients i.e. Ca, S, Mg, N, P, K, present in the soil N, P and K are required by the plants in relatively large quantities and thus are known as primary nutrients. Soil tests were done for NPK at soil testing laboratory, Directorate of Agriculture, Lalmundi, Srinagar by using following respective methods:

1. Ph by standard pH meter in a 1:2 soil-water suspension.
2. Organic carbon (OC) by Walkley and Black rapid titration method (1934).
3. Available nitrogen (N) by Alkaline Permanganate Method (Subbiah and Asija, 1956).
4. Available phosphorus (P) by Olsen's Method (1954).
5. Available potassium (K) by flame photometry as described by Jackson, 1973.

Based on the content of NPK in the soil, was categorized into fertility classes as low, medium and high as per the following table:

Table: 1 Rating chart for soil test values

Nutrients	low	Medium	High
N(kg/ha)	<272	272-544	>544
P2O5(kg/ha)	<22.5	22.5- 56	>56
K2O(kg/ha)	<136	136-337	>337

Source: Adopted STL, Department of Agriculture, J&K Government.

Nutrition index was then computed by applying the formula:

$$\text{Nutrition Index(NI)} = \frac{NL + 2Nm + 3Nh}{NL + Nm + Nh}$$

Where NL, NM, NH are the number of soil samples falling in the category of low medium and high nutrient status as per the rating chart for the soil test values. Values of 1, 2, and 3 are the weights given to low, medium and high soil category respectively (Biswas and Mukerjee -1994).

Table: 2 Soil Fertility Class

Nutrients	low	Medium	High
N(kg/ha)	<5	5-75	>75
P2O5(kg/ha)	<10	10-25	>56
K2O(kg/ha)	<120	120-280	>280

Source: USAID, New Delhi, p.85

On the basis of the index values (NI), the south Kashmir has been divided into four soil fertility zones.

Results and Discussion:

The study clearly depicts that fertility status in terms of macro nutrients like NPK varies from high to very low with interzonal variations. The high fertility is found in Zone I with high nutrition index (NI) of more than 3.0 covering

an area of 422.29 km² with 10.2 percent. The reason being the zone is mostly a low lying plain area and farmers are conscious about fertility status as this is dominated by cereals crops. Medium fertility was found in the Karewa of Shopian, Kulgam, Anantnag, Pampore, Koil, Tral and Shadimarg areas of the study area having NI within the range of 2.5-3.0. While the low nutrition index of 1.5-2.5 was found in undulating foothills with slope ranging from 15-20. However very low nutrition index was found in the mountainous hamlets especially Sangarwani and Sonbanjar (Shadimarg), Nargisthan and Purngam (Tral) areas of Pulwama, Phalipora and Aharbal areas of Shopian, Tangmarg and Tengam of Kulgam and hilly areas of Ashmuqam, Lidru in Anantnag district. The Nitrogen (N) content in the soil of South Kashmir Himalayas ranges from 91.90- 22.47 kg/hectare with a mean 52.165 kg/hectare in the surface zones (0-20 cms) while the value of same nutrient in the sub-surface zone ranges from 78.36-16.300 with a mean of 43.719 kg/hectare at sub-surface level of 20-100 cms. Similarly, the value of Phosphorus (P) at surface level was 11.250 to 3.200 kg/hectare with mean value of 7.167 while its concentration was 8.400 to 2.45 kg/hectare with a mean of 5.33 at sub-surface level. So was found in the concentration levels of Potassium (K) with 524.600 to 395.240 and mean of 406.987 at surface level and 485.200 to 371.300 with mean of 3.83.238 at sub-surface level. The study also reveals the inter-zonal variations in the concentration of macronutrients (N, P, K) which is purely highlighted in table 3.

The soils of South Kashmir Himalayas revealed greater discrepancy in the fertility status especially in macronutrient analysis across altitudes. (Gupta R.D., Upadhyaya V.K. 2009) found that macronutrient status varies in soil with respect to biosequence in terms of forest showing deficiency of N and K, as compared to cultivated and grasslands. The fertility status decreases with increasing altitude (Lone and et al. 2013) which is attributed to change in slope from gentle to steep and increase in the intensity of soil erosion as was revealed by (Bhat and Kanth,1991) using universal soil loss equation ranging from 16 tons/hectare/year in Jhelum valley floor. High nutrition index (NI) was found in Plains of Jhelum Valley in zone I (Table 3, fig. 2) which is mainly attributed to loamy soils present there. These soils are rich in nitrogen compounds, organic matter and other plant nutrients especially from horticulture fields as compared to Karewa soils which are deficit in nitrogen and phosphorus levels. However, the concentration of Potassium (P) levels is higher at low and very low fertility zones. The reasons could be low vegetal cover, over grazing and low organic content.

The interzonal variations are quite high in all the nutrients phosphorus depicts more than 40 percent variation which is attributed to immiscible character of phosphorus loss, due to leaching is minimum as compared to its counterparts like nitrogen and Potassium which reveals many folds variations as the soils of Kashmir valley in general and soils of south Kashmir in particular had undergone tremendous change as change in the land use and cover and practicing of agriculture has been modified at large.

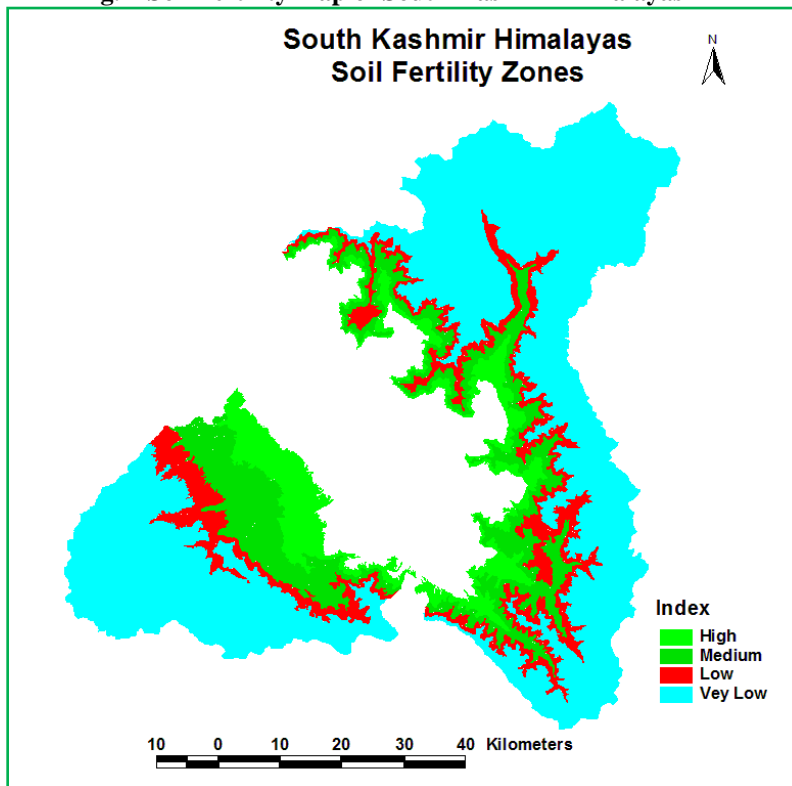
So these deficiencies can be overcome by using modern biofertilizer abundantly taken into consideration the requirement of the soil both in quantity as well as quality approved by the agriculture department from time to time, besides manuring to increase the nutrient balance. The mono crop culture practiced at higher altitudes should be replaced by mixed cropping or HYV seeds to bring home the benefits the management of soils.

Table 3: Soil Fertility Zones in South Kashmir in Relation to Concentration of Macronutrients (NPK)

Concentration of Primary Nutrients (NPK) in Kg/hectare										
Soil Fertility Zone	Fertility Status	Nutrition Index (NI)	Slope (Deg.)	Area (Km ²)	Nitrogen		Phosphorus		Potassium	
					Surface	Sub-surface	Surface	Sub-surface	Surface	Sub-surface
I	High	>3.0	5-10	422.29	91.90-73.90 (-83)	78.36-74.23 (-76.295)	11.250-8.540 (-9.895)	8.400-4.520 (-6.46)	524.600-498.570 (-511.585)	485.200-420.550 (-452.875)
II	Medium	2.5-3.0	10-15	360.04	73.45-63.54 (-68.49)	63.500-54.378 (-58.939)	9.400-6.700 (-8.05)	7.200-5.200 (-6.2)	354.200-234.250 (-294.225)	325.200-274.36 (-299.78)
III	Low	1.5-2.5	15-20	337.12	33.50-29.54 (-31.72)	25.61-19.78 (-22.695)	7.450-5.200 (-6.325)	6.100-4.52 (-5.31)	436.470-387.360 (-411.915)	405.000-368.700 (-386.85)
IV	Very low	<1.5	Above 20	294.28	28.45-22.47 (-25.45)	17.600-16.300 (-16.95)	5.600-3.200 (-4.4)	4.250-2.45 (-3.35)	425.210-395.240 (-410.225)	415.600-371.300 (-393.45)
Total					91.90-22.47 (-52.165)	78.36-16.300 (-43.719)	11.250-3.200 (-7.167)	8.400-2.45 (-5.33)	524.600-395.240 (-406.98)	485.200-371.300 (-383.238)

Source: Computed from soil tests done at Soil Testing Lab. Lal Mundi Srinagar J&K 2013-2014

Fig. 2 Soil Fertility map of South Kashmir Himalayas



Source: Based on the results of Table 3

Acknowledgement:

The authors are highly thankful to Mr. Shahnawaz Ahmad Dar and Miss Asifa Jan, Research Officer, Soil testing Lab, Lal Mandi Srinagar and her team for heartfelt help and coordinational support in guiding the authors in a right direction.

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