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Macronutrients distribution in submontnae soils of the Jammu in relation to soil properties

Vijay Kumar and KR Sharma

Abstract
Submontane soils are alluvium deposited in the valley floor by the Jhelum and the Indus Rivers of the Jammu are prone to deficiency of macronutrients. Four profiles from forest, horticulture, agriculture, pasture and degraded lands in the submontane tract Jammu were investigated for available N, P, K and S. The available macronutrients varied from 27.44-128.24 for N, 2.94-18.24 for P, 28.93-70.88 for K and 0.19-5.75 mg kg^{-1} for S. The available macronutrients were superior in fine textured soil than in coarse-textured soils. Soil texture was dominant in sandy loam than sandy clay loam with variation in relation to topography. Organic carbon, pH, clay and silt content exerted strong influence on the distribution of macronutrients. The available macronutrients N, P, K and S increased with increasing organic carbon content but decreased with increase in pH. The available macronutrients content increase in clay and silt contents and reduced with increase in sand content. The results revealed that the nutrients declines as land use changed from forest to pasture and cultivated lands. Hence, it is potential to assume that continuous and intensive cultivation reduces plant nutrients critically which need to take actions for maintaining its macro-nutrients status for the horticulture and Agriculture soils in the study areas.

Keywords: Available macronutrients; macronutrients distribution; submontane soils; soil characteristics; land uses

Introduction
Soil quality can be valuable by land use systems and Agriculture management practices which might be due to modification in land productivity (Islam and Wail 2000) [15]. The soil properties are liable for change in the land use dynamics as soil nutrients are closely consistent to the diverse land use systems and their related to management practices (Reijneveld *et al*. 2009) [38]. The soil nutrients forms, availability and movement in their uptake by roots and the consumption within plants are narrowly related (Foth and Ellis 1997).

The macronutrient are essential in soil to plants growth, sustain ecosystems and great crop yields. The inequality fertilization, depreciate the valuable soil environment particularly nitrogen and phosphorus could be due to potentially hazardous of water resources while their constituents in soils are extreme, as available macronutrients may be transported off site in runoff due to rain or irrigation and subsequently degrades the soil and reduced the productivity (Ju *et al*. 2007) [19]. Consequently proper management practices are compulsory to avoid failing environment whereas meeting the requirement of extraordinary crop productivity and farmer must be advised to use unique fertilizers, manures, and accordingly take on suitable cropping pattern.

Soil fertility is one of the imperative factors governing by the crop yield and productvity. Soil associated restrictions affecting the crop productivity including nutritional disorders may be resolute by evaluating the fertility status of the soils. The nutrient deficiencies in soils are the major constraints to productivity, stability and sustainability of the soils (Chaudhari *et al*. 2012) [3]. The nutrient availability in soil depends upon soil pH, organic matter, adsorptive surfaces and other physical, chemical and biological conditions in the rhizosphere (Jiang *et al*. 2009) [18]. Soil pH is one of the attributes delicate to changes in the natural environment and soil management developments for human activity. The fertility of the soil are the major indicator i.e. organic matter, cation exchange capacity (CEC), pH and soil texture. The soil pH is decreasing trend with increasing number of years in cultivation (Agriculture and horticulture) as soils tend to be slightly leached and become acidic in reaction (Jaiyeoba 2003) [17]. The organic matter is a dynamic in soil and large pool of carbon which is subject to change due to changes in management practices as a product of changing land use systems (Post and Kwon 2000) [36]. Organic matter is a plays vital role in regulating the flow, supply of plant nutrients and water flow and determining physical attributes of soils (Cotrufo *et al*. 2011) [6]. The climatic conditions are particularly temperature and rainfall, in turn bring about significant influence on amounts of nitrogen and organic matter found in soils. Nevertheless, the effect of due to land use changes on organic matter content depends on a number of factors such as the old and new land use kinds, soil type, management and climate (Lettens *et al*. 2004) [23]. They have profound effects on organic matter build-up and CO_2 evolution. These changes typically consequence in differing rates of soil erosion, aggregate formation, biological activity, and drainage. However, forest and pasture lands make up the potential to build up large amounts of organic materials while as conversion of natural ecosystem to croplands which outcomes in high rate of its turnover leads to declined organic matter level (Batjes 2004) [1].

The maintaining soil fertility is one of the most important factors for increasing population and to requisite for human food. The macronutrients levels were comparatively low in smooth manufacturing areas and the content was comparatively more in the forest areas (Gandhe 2015) [10]. Similarly, the available macronutrients was also studied in the soils of Kashmir in relation to soil properties and found vast difference among available macronutrients (Maqbool *et al*. 2017) [27]. Although efforts are underway to ameliorate the soil by applying inorganic amendments, bio-fertilizers and by following certain practices, adequate attention has not been paid to study the distribution of macronutrients in the soil depth and the way it can control the availing macronutrients. Conversely, the information on macronutrients status of the present study areas is insufficient. The present investigation aims to study the distribution of macronutrients in soils depth located in submontane regions of north-western India and their association with soil characteristics and to provide information to the farmer regarding nutrient accessibility in soils. The baseline data so generated can outline the basis for the fertilizer recommendations for maximizing crop yields and further to maintain the most favourable fertility in soil year after year.

Materials and methods

Study site

The study areas (submontane region) is under sub-tropical climate and is located north-western region of India in the state Jammu and Kashmir and lies between 36^0 58'-37^0 17'N latitude and 73^0 26'-80^0 30'E longitude forming a part of Hill and Mountain ecosystem of India. The annually rainfall of 1100 mm occurs from about 70 to 80 per cent from July to September and with a very high intensity of the South-West monsoon. The present study was conducted at the Sher-e-Kashmir University of Agricultural Sciences and Technology-Jammu in submontane areas of north-western Himalayas India. The rainfall distribution patterns are especially erratic in time, space, frequency and distribution leads to moisture stress condition during the major part of the year. The mean average temperature of the area is 27 ^{0}C with highest and lowest mean annual temperature of 33 ^{0}C and 21 ^{0}C, respectively. Structurally and constituent-wise, the submontane hills are moderate erosion, slight to moderate stoniness and occasional flooding are the major constraints to landuse.

Methods

Soil samples were collected from five different land use systems i.e. forest, horticulture, agriculture, pasture and degraded lands. In each landuse for five sities were selected at different locations. Further, at each sities, five samples were collected and each site, the samples were collected from four places to prepare a composite sample. Agriculture system included samples from predominantly maizewheat system, whereas mango orchards represented the horticultural system. Forests were mixed and changed with altitude. Pasture land were grazing of animals with small bushes and natural grasses in these areas. Degraded lands were either no vegetation or scanty areas.

The soils were collected from up to a depth of 0–15cm and 15-30 cm, 30-60 cm and 60-100 cm. The soil samples were air-dried and ground to pass a 2-mm sieve for determining various soil properties. Soil reaction was determined in 1:2.5 soil: water suspension ratio (w/v) with the help of glass electrode pH meter (Jackson, 1973) [16]. The electrical conductivity (EC) was measured with a conductivity meter in a 1:2.5 (w/v) soil: water suspension ratio by Jackson (1973) [16]. Soil texture was determined in the mechanical analysis by hydrometer method (Piper, 1966) [35]. The bulk density and particle density were determined by Chopra and Kanwar (1991) [5]. Soil organic carbon (SOC) content was determined by the Walkley-Black method with dichromate extraction and titrimetric quantization (Nelson and Sommers, 1986) [32]. Maximum water holding capacity was determined by Keen Roezkowski box method (Chopra and Kanwar, 1991) [5]. Available Nitrogen was determined by using alkaline permanganate method (Subbiah and Asija 1956) [45]; available phosphorus was determined by Olsen and Sommers (1982) [34]; available potassium was analysed by extraction with 1 N ammonium acetate at pH 7 (Jackson, 1973) [16] and available sulphur was determined turbidimetrically using barium chloride (Chesnin and Yein 1951) [4].

Results and discussion

Physical and chemical properties

Perusal of data on soil pH in table 1 representing that pH in all landuse systems varied from slightly acidic to neutral alkaline in reaction. The pH of the soils ranged from forest 6.30-7.62, horticulture 6.35-8.05, Agriculture 6.15-8.15, pasture 6.13-7.60 and degraded 6.75 -8.16. The highest pH in degraded land (wm =7.62) followed by Agriculture (wm =7.34), horticulture (wm =7.23), forest (wm =7.15) and was lowest in (wm =7.08) pasture land. The slightly acidic to neutral alkaline pH may be attributed to the soil reaction of useful fertilizer material with soil colloids, which resulted in the reaction of basic cation on the exchangeable complex of the soil (Singh and Mishra 2012) [42]. The pasture soil lowest pH value which might be due to acidic nature of decomposing biomass litter while as degraded lands showed highest pH values could be attributed to the accumulation of bases there (Regmi and Zoebisch 2004) [37]. This increase in soil reaction values of submontane soil could be due to undulating topography of bases from higher topography (Sarkar *et al*. 2001) [39].

Table 1: Range and weighted mean (wm) of some selected properties of submontnae soils of Jammu state in India

Statistical parameters	Sand (%)	Silt (%)	Clay (%)	pH (1:2.5)	EC (d Sm^{-1})	OC (g kg^{-1})	BD (g cm^{-3})	PD (g cm^{-3})	MWHC (%)
Forest									
Range	58.42-72.24	11.34 -21.23	10.43-25.66	6.30-7.62	0.03-0.21	1.42-6.23	1.30-1.48	2.42-2.67	32.47-45.78
Wm	66.26	15.35	18.12	7.15	0.11	3.59	1.39	2.57	39.10
Horticulture									
Range	58.22-71.48	13.39-29.46	8.12-24.47	6.35-8.05	0.03-0.25	1.13-5.94	1.39-1.67	2.48-2.73	29.69-46.54
Wm	64.63	19.55	16.43	7.23	0.11	3.05	1.53	2.60	35.71
Agriculture									
Range	58.14-72.45	9.48-17.48	10.10-28.40	6.15-8.15	0.03-0.28	1.84-4.67	1.38-1.66	2.55-2.69	29.01-39.01
Wm	65.95	13.37	20.35	7.34	0.11	2.82	1.55	2.63	33.57
Pasture									
Range	58.36-68.45	13.42-23.48	14.10-26.08	6.13-7.60	0.04-0.26	0.85-6.94	1.27-1.47	2.33-2.58	32.28-46.07
Wm	63.56	18.49	18.36	7.08	0.09	4.05	1.38	2.45	37.29
Degraded									
Range	54.46-70.23	11.46-29.42	8.30-26.16	6.75-8.16	0.07-0.50	0.71- 4.53	1.49-1.65	2.58-2.74	21.04-34.00
Wm	62.73	20.13	16.89	7.62	0.17	2.68	1.60	2.68	26.99

The electrical conductivity of the soils ranged from forest 0.03-0.21, horticulture 0.03-0.25, Agriculture 0.03-0.28, pasture 0.04-0.26 and degraded 0.07-0.50 dSm^{-1} under different landuse systems (Table 1). The highest electrical conductivity in degraded land (wm =0.17 dSm^{-1}) and was lowest in (wm =0.09 dSm^{-1}) pasture land. The similar values of EC in agriculture, horticulture and forest are (wm =0.11 dSm^{-1}) under different land use systems. The EC values of the soils indicate that these soils were free from salinity hazard. The high value of EC in degraded land as compared to other land use systems which could be due to attributed of accumulation of soluble salts in soil (Verma *et al*. 2007) [47]. Owing to high precipitation and less evaporation demand, the salt accumulation is not predominant in this region, which is suitable for crop growth.

The soils in the forest lands were found to have highest sand percentage and were mostly sandy loam in texture (Table 1). The highest clay content was observed in agriculture land, whereas lowest was observed in horticulture lands. The higher clay content in the agriculture land could be attributed to the process of mechanical operation by plough of parent material. A similar result was obtained by Gupta and Tripathi (1992) [13] in North-West Himalayan soils. High sand content in forest lands might be due to the richness of parent material along with its fraction. The dominant textural class was sandy loam followed by sandy clay loam. Similar results obtained by Gupta (1994) [14]. Although soil texture is inherent property, this might be attributed to accelerated weathering as a result of disturbance during continuous cultivation by Boke (2004) [2]. The soil texture of the different land use systems were found to be the same except for that of agriculture, which was sandy clay loam. This proposes that the different land use systems did not have effect on the soil texture of the submontane soils, since texture is an natural soil property that not influenced in short period of time.

The organic carbon of the soils ranged from pasture forest 1.42-6.23 horticulture 1.13-5.94, agriculture 1.84-4.67, pastures 0.85-6.94 and degraded 0.71-4.53 g kg^{-1} under different landuse systems (Table 1). The highest organic carbon in pasture land (wm =4.05g kg^{-1}) followed by forest (wm =3.59 g kg^{-1}), horticulture (wm =3.59g kg^{-1}), agriculture (wm =2.82g kg^{-1}) and was lowest in (wm =2.68 g kg^{-1}) degraded land use systems. It was due to the fact that in pasture soils the shallow roots of the grasses are limited only to the surface layer thus accounting for the higher surface organic carbon by (Debasish-Saha *et al*. 2011) [7]. The higher values of organic carbon in forest and horticulture land which might be due to attributed to the higher biomass production and lower decomposition rate at higher reaches (Yitbarek *et al*. 2013) [49]. In the agriculture was lower values in forest and horticulture systems is due to continuous organic matter oxidation subjected to anthropogenic activities (Najar *et al*. 2009) [30] whereas lower values of organic carbon in degraded lands is due to scanty area or sparse vegetation and no application of organic residues (Mansha and Lone 2013) [26].

The bulk density of the soils ranged from forest 1.30-1.48, horticulture 1.39-1.67, Agriculture 1.38-1.66, pastures 1.27-1.47 and degraded 1.49-1.65 g cm^{-3} under different landuse systems. The highest bulk density in degraded land (wm =1.60 g cm^{-3}) followed by agriculture (wm =1.55 g cm^{-3}), horticulture (wm =1.53 g cm^{-3}), forest (wm =1.39 g cm^{-3}) and was lowest in (wm =1.38 g cm^{-3}) pasture land use systems (Table 1). The increase in bulk density in degraded land which might be due attributed to less organic matter, more compaction and less aggregation in soil of submontane areas. Submontane soil whereas higher bulk density values which might be due to their sandy soil and less organic matter content. Similar results are reported by (Swarnam *et al*. 2004) [46]. The compaction subsequent from intensive cultivation might have caused the relatively higher bulk density values in the degraded land than that of the cultivated lands. Liu (2010) [24] reported that the land use and soil management practices influence the soil nutrients and related soil processes, such as soil erosion, oxidation, mineralization and leaching etc. Moreover, in degraded land, the type of vegetative cover is a factor influencing the soil organic carbon content and land use change also produces considerable alterations. Fu *et al*. (2000) [9] observed that the generally soil quality diminishes after the cultivation of formerly fallow soils. The bulk density is relatively low on pasture and forest lands as well as horticulture land could be due to the uppermost organic matter content and low clay content, respectively. Similarly, Gol (2009) [12] also investigated the effects of land use change on soil properties and organic carbon at Dagdami river catchment in Turkey and bulk density as affected by land use in Ethiopia (Neris Jiménez 2012) [33].

The particle density of the soils ranged from forest 2.42-2.67, horticulture 2.48-2.73, Agriculture 2.55-2.69, pastures 2.33-2.58 and degraded 2.58-2.74 g cm^{-3} under different landuse systems (Table 1). The highest particle density in degraded land (wm =2.68 g cm^{-3}) followed by agriculture (wm =2.63 g cm^{-3}), horticulture (wm =2.60 g cm^{-3}), forest (wm =2.57 g cm^{-3}) and was lowest in (wm =2.45 g cm^{-3}) pasture land use systems. The porosity was higher in degraded land and was lowest in pasture lands. Increase in the particle density in degraded land with scanty vegetation areas are higher which could be due to lower organic matter content and more sand content in soil (Leelavathi *et al*. 2009) [22].

The maximum water holding capacity of the soils ranged from forest 32.47-45.78, horticulture 29.69-46.54, agriculture 29.01-39.01, pastures 32.28-46.07 and degraded 21.04-34.00 per cent under different landuse systems (Table 1). The highest maximum water holding capacity in forest land (wm =39.10%) followed by pasture (wm =37.29%), horticulture (wm =35.71%), agriculture (wm =33.57%) and was lowest in (wm =26.99) degraded land use systems. The difference in the water holding capacity under different landuse systems which might be due to the variation in clay and organic carbon content and heterogeneity of parent material in soils (Sathyavathi and Reddy 2004) [40]. Gol (2009) [12] also reported that the maximum water holding capacity in forest soil could be attributed to high soil organic matter and finer clay content in the submontane soils under different land use systems.

Reserves of macronutrients

Available nutrients

The available nitrogen content in submontnae soils under different land use systems varied from 42.72-126.04 mg kg^{-1} (wm =75.18 mg kg^{-1}) (Table 2 and Figure 2). It was highest in sandy loam soils in forest land (wm =80.93 mg kg^{-1}) followed by pasture land (wm =79.61 mg kg^{-1}), horticulture (wm =79.05 mg kg^{-1}), agriculture (wm =72.08 mg kg^{-1}) and was lowest in (wm =64.21 mg kg^{-1}) degraded land under different land use systems. The nitrogen content availability not only an important part of the carbohydrates, fats and oils but also an essential ingredient of proteins. The available nitrogen is an essential aspect to increase the fertility of the soils. It was attributed due to high organic matter and overall high turnout of nitrogen during decomposition in forest as compared to other landuse systems. The results are in agreement with the findings of (Yihenew *et al*. 2015; Maqbool *et al*. 2017) [48, 27]. The low nitrogen content in the soils which might be due low quantity of organic carbon in the soils and uncertain precipitation has a foremost impact on availability of nitrogen (Singh *et al*. 2015) [43].

The available phosphorus content in submontnae soils under various land use systems varied from 6.04-14.15 mg kg^{-1} (wm =10.07 mg kg^{-1}) (Table 2 and Figure 2). It was highest in sandy clay loam soils in agriculture land (wm =11.18 mg kg^{-1}) followed by forest land (wm =10.63 mg kg^{-1}), pasture (wm =10.47 mg kg^{-1}), horticulture (wm =10.29 mg kg^{-1}) and was lowest in (wm =7.77 mg kg^{-1}) degraded land under various land use systems. Available phosphorus content under different land use systems was found to be higher agriculture land than those other landuse systems. This might be due to the application of manure and Diammonium phosphate (DAP) fertilizer on the agriculture and horticulture land may have resulted enhance in phosphorus in the soil in line with the explanation (Gebeyaw 2007) [11] and far above the ground organic matter in forest and pastures land on the decomposition of leaf litter which release organic anions and types of chelates with Fe and Al and make the phosphorus available forms. The results are similar with the findings of Najar (2002) [29]. The available phosphorus content which might be due to fixed phosphorus pool of phosphate contains inorganic phosphate compounds that are very insoluble and organic compounds that are impervious to mineralization through microorganisms in the soil (Meena *et al*. 2006) [28].

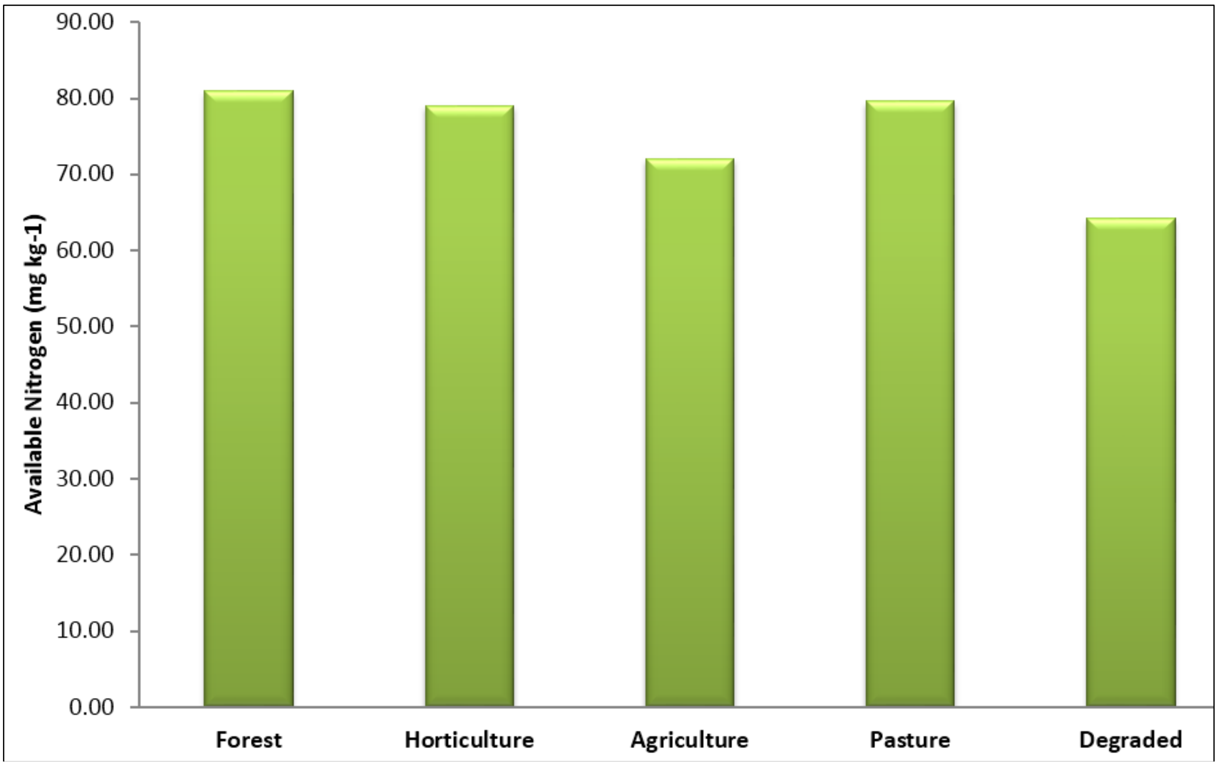
The available potassium content in submontnae soils under different land use systems varied from 36.16-57.65 mg kg^{-1} (wm =44.37 mg kg^{-1}) (Table 2 and Figure 2). It was highest in sandy loam soils in horticulture land (wm =47.96 mg kg^{-1}) followed by agriculture land (wm =47.78 mg kg^{-1}), forest (wm =45.84 mg kg^{-1}), pasture (wm =41.23 mg kg^{-1}) and was lowest in (wm =39.04 mg kg^{-1}) degraded land under various land use systems. The addition of organic matter raises the amount of exchangeable cations bases and the low cations bases in the agriculture and horticulture fields could be due to the intensive cultivations (Urioste *et al*. 2002). Negassa (2001) [31] reported that the continued use of inorganic fertilizers which improves the loss of base cations through erosion, crop harvest and leaching process. This intensity of weathering, farming and use of acid forming inorganic fertilizers affect the distribution of K in the soil system and enhance its depletion (Malo *et al*. 2005) [25]. Singh *et al*. (2012) [42] observed that the K content in agro-forest, home gardens and shifting cultivation was comparatively lower than natural forest.

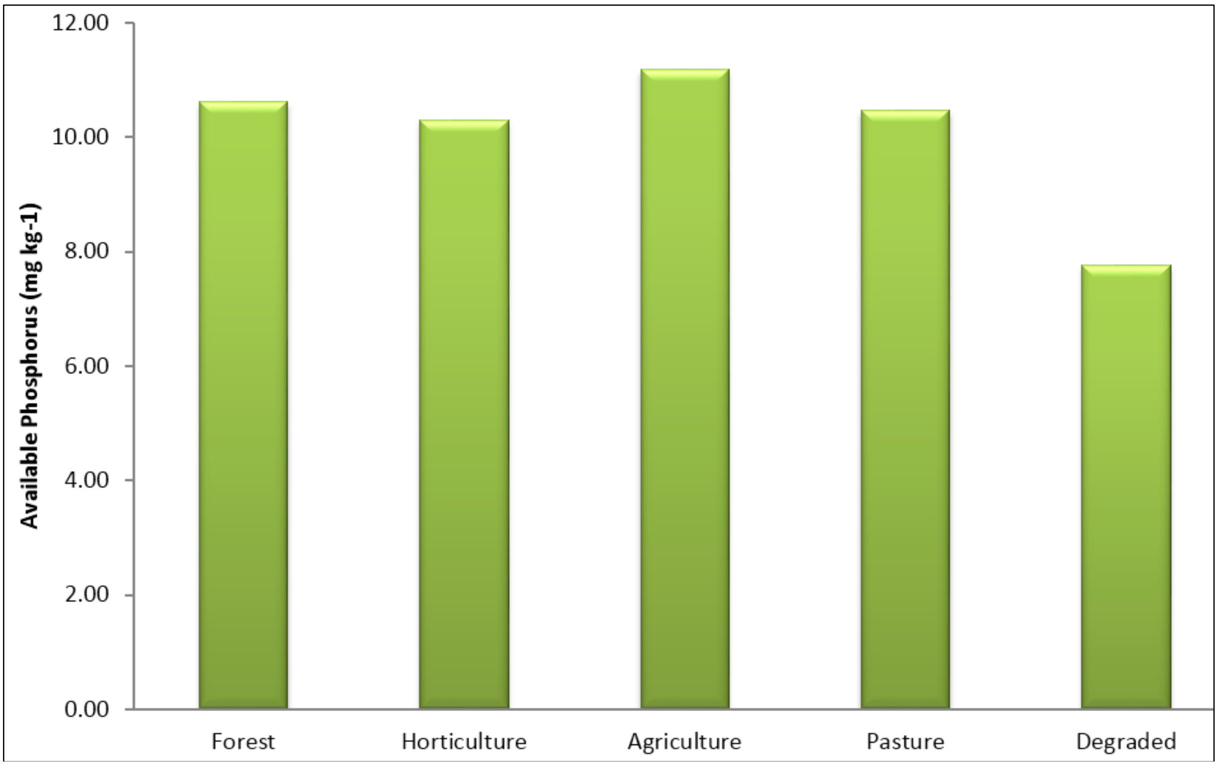
Table 2: Available macronutrients in submontnae soils of the Jammu, India

		Available macronutrients (mg kg^{-1})			
Land use	**Depth (cm)**	**Nitrogen**	**Phosphorus**	**Potassium**	**Sulphur**
Forest: sandy loam					
	0-15	115.00	11.41	52.63	2.59
	15-30	96.04	10.56	48.83	1.96
	30-60	78.00	13.99	45.61	1.14
	60-100	64.68	7.84	42.35	0.72
Horticulture: sandy loam					
	0-15	110.08	13.89	57.65	3.78
	15-30	93.56	15.39	52.75	2.65
	30-60	77.72	10.27	47.95	1.31
	60-100	62.96	7.05	42.53	0.69
Agriculture: sandy clay loam					
	0-15	100.80	14.15	55.07	3.16
	15-30	89.44	14.99	50.78	2.62
	30-60	68.36	10.85	48.44	1.40
	60-100	57.60	8.89	43.41	1.18
Pasture: sandy loam					
	0-15	126.04	12.95	49.18	2.95
	15-30	100.56	13.04	43.37	2.06
	30-60	74.56	9.67	41.32	1.20
	60-100	58.12	9.19	37.38	0.62

Degraded: sandy loam					
	0-15	98.96	10.42	43.85	2.43
	15-30	87.68	7.94	41.41	1.57
	30-60	63.76	8.66	39.27	0.78
	60-100	42.72	6.04	36.16	0.59
Weighted mean		75.18	10.07	44.37	1.43

The available sulphur content in submontnae soils under different land use systems varied from 0.59-3.78 mg kg^{-1} (wm =1.43 mg kg^{-1}) (Table 2 and Figure 2). It was highest in sandy clay loam soils in agriculture land (wm =1.76 mg kg^{-1}) followed by horticulture land (wm =1.63 mg kg^{-1}), pasture (wm =1.36 mg kg^{-1}), forest (wm =1.31 mg kg^{-1}) and was lowest in (wm =1.07 mg kg^{-1}) degraded land under various land use systems. Thus, the soils of agriculture land as compared to other landuse systems are likely to well respond to sulphur fertilization.





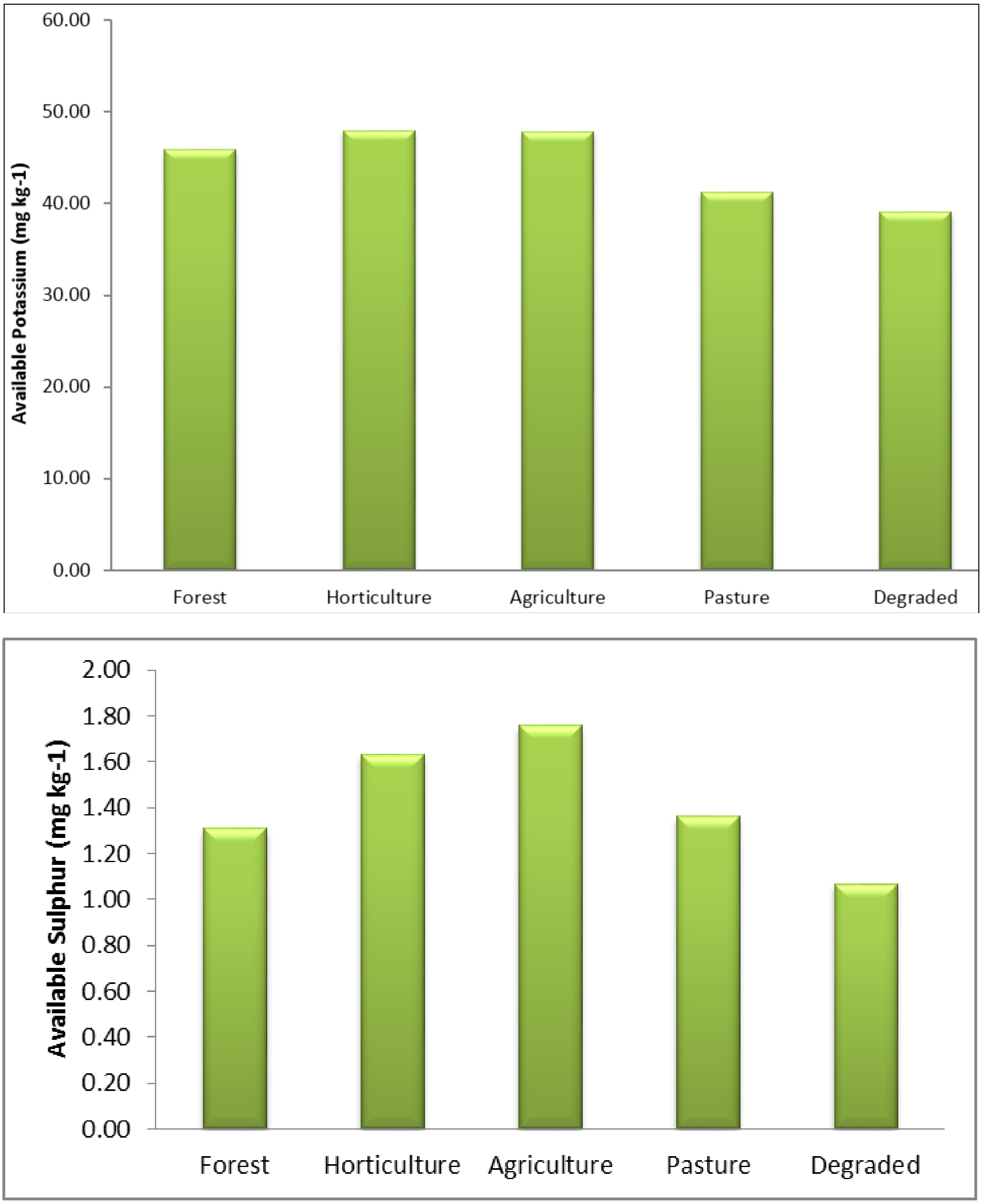


Fig 1: Effect of different landuse systems on distribution of available macronutrients (weighted mean) in submontnae soils

The higher available sulphur in these soils is due to sulphur bearing minerals. These results are similar with the studies of (Singh and Mishra 2012) [42]. Farida *et al*. (2008) reported that the high organic matter in agriculture as compared to horticulture land might be due to the leads of removal of more for protein synthesis.

Correlation between soil properties and available macro-nutrients in submontane soils

As revealed by the significant (p=0.05) and positive coefficient of correlation (Table 3) in between soil properties and available nutrients in submontane soil of North-western India are presented in soil pH was positive and significant correlation with EC (r =0.946*) and bulk density (r =0.882*) whereas negative and significant correlation with MWHC (r =-0.967**). The organic carbon content was positive correlation with available N and P while as negative and significant relationship with bulk density (r =-0.964**) and particle density (r =-0.963**). The organic carbon status of the soil can forecast the available N which shows positive relationship. Similarly organic carbon level also markedly affects the soil N levels and the results are in agreement with (Meena *et al*. 2006; Kumar *et al*. 2009; Sharma *et al*. 2008) [28, 21, 41].

Table 3: Correction coefficient of soil properties and available macronutrients in submontnae soils

	pH	EC	OC	BD	PD	MWHC	Avail. N	Avail. P	Avail. K
EC	0.946*								
OC	-0.857	-0.718							
BD	0.882*	0.731	-0.964**						
PD	0.867	0.799	-0.963**	0.880*					
MWHC	-0.967**	-0.894*	0.770	-0.861	-0.733				
Avail. N	-0.967**	-0.876	0.767	-0.824	-0.746	0.978**			
Avail. P	-0.784	-0.906*	0.429	-0.527	-0.498	0.813	0.741		
Avail. K	-0.397	-0.526	-0.126	-0.025	0.074	0.520	0.497	0.767	
Avail. S	-0.360	-0.605	-0.118	0.073	-0.054	0.370	0.352	0.789	0.865

The bulk density was positive and significant correlation with particle density (r =0.880*). MWHC was positive and significant correlation with available N (r =0.9780*). The available N was negative and significant with pH (r =-0.967**), EC and BD and PD relationship reported by (Somasundaram *et al*. 2013; Kartikeyan *et al*. 2014) [44, 20]. The available P was negative and significant with EC (r =-0.906*). -Organic carbon was positive and significant correlation with MWHC. Similar results in soil of Mewar region of Rajasthan and Janjgir (2012) district of Chhattisgarh. The available potassium was PD, MWHC and available P, K and S. The results are accordance with the findings of Chauhan (2001). Available sulphur in these soil show negatively significant correlation relationship with pH, EC, particle density and organic C. The sulphur was positively relationship established between BD and MWHC and available N, P and K, these results corroborate the finding of (Meena *et al*. 2006) [28].

Conclusions

The availability of macronutrients N, P, K and S constitutes a major constraint under different land use systems in submontane soils in Northwestern India; high soil reaction and electrical conductivity are responsible for decreased activity of the macronutrients elements ensuing in declined availability of available N, P, K and S. The available macronutrient content in these soils was influenced primarily by parent material were determined by soil pH, soil texture and organic matter content of the soil. The availability of macronutrients can be predicted qualitatively from a physical and chemical properties especially organic matter content and pH of the soils. Changes in soil pH, organic matter content and size fractions i.e. clay and silt had strong influence on the distribution of macronutrients. The soil quality and health were preserved under forest and pasture, while as the inspiration on most parameters were negative on the soils of cultivated land and degraded land, suggesting the need for intervention so as to optimize and sustain the soil quality in case of cultivated and also degraded lands. Especially stress should be certain for management of soil organic matter as several physico-chemical properties are positively correlated with it.

References

1. Batjes H. Soil carbon stocks and projected changes according to land use and management: a case study for Kenya. Soil Use and Management. 2004; 20:350-356.
2. Boke S. Soil phosphorus fractions as influenced by different cropping systems in Andosols and Nitosols in Kembata-Tembaro and Wolayta Zones, SNNPRS. MSc Thesis. Alemaya University, (AU). P, 2004, 131.
3. Chaudhari PR, Ahire DV, Vidya Ahire D. Correlation between Physicochemical properties and available nutrients in sandy loam soils of Haridwar. Journal of Chemical. Biological and Physical Sciences. 2012; 2(3):1493-1500.
4. Chesnin L, Yien CH. Turbidimetric determination of available sulphate. Soil Science Society of America Proceedings. 1951; 15:149-151.
5. Chopra SL, Kanwar JS. Analytical Agricultural Chemistry. Kalyani Publishers, New Delhi-Ludhiana, 1991.
6. Cotrufo F, Conant R, Paustian K. Soil organic matter dynamics: land use, management and global change. Plant Soil. 2011; 338:1-3.
7. Debasish S, Kukal SS, Sharma S. Landuse impacts on SOC fractions and aggregate stability in typicustochrepts of Northwest India. Plant Soil. 2011; 339:457-70.
8. Foth HD, Ellis BG. Soil fertility, 2nd Ed. Lewis CRC Press LLC. USA. 290.
9. Fu Che BL. The relationships between land use and soil conditions in the hilly area of the loess plateau in northern Shaanxi, China. Catena. 2000; 39:69-78.
10. Gandhe A. A study of macronutrients in soils of different places around Indore, MP, India. Research Journal of Chemical Sciences. 2015; 5:53-56.
11. Gebeyaw T. Soil fertility status as influenced by different land uses in Maybar areas of south wello Zone, North Ethiopia. M.Sc. Thesis. Haramaya University, Ethiopia, 2007, 71.
12. Gol. Effects of Land Use Change on Soil Properties and Organic Carbon at Dagdami River Catchment in Turkey. Journal of Environmental Biology. 2009; 30:825-830.
13. Gupta RD, Tripathi BR. Genesis of soils in wet temperate and sub-alpine/moist-alpine climatic zones of the North-West Himalayas. Journal of the Indian Society of Soil Science. 1992; 40:506-512.
14. Gupta RD. Characterization of eroded soils of kandi belt of Jammu district, Jammu and Kashmir State. M.Sc. Thesis. Sher-e-Kashmir University of Agricultural sciences and Technology of Jammu, Jammu, India, 1994.
15. Islam KR, Wail RR. Land use effect on soil quality in tropical forest ecosystem of Bangladesh. Agriculture, Ecosystem and environment. 2000; 7:9-16.
16. Jackson ML. Soil chemical analysis: Advanced course. The Author. Madison, Wisconsin, USA, 1973.
17. Jaiyeoba IA. Changes in soil properties due to continuous cultivation in Nigerian semiarid Savannah. Soil Tillage and Research. 2003; 70:91-98.
18. Jiang Y, Zhang YG, Zhou D, Qin Y, Liang WJ. Profile distribution of micro-nutrients in an aquic brown soil as affected by land use. Plant Soil Environ. 2009; 55:468-476.
19. Ju XT, Kou CL, Christie P, Dou ZX, Zhang FS. Changes in the soil environment from excessive application of fertilizers and manures to two contrasting intensive

cropping systems on the North China Plain. Environ. Poll. 2007; 145(2):497-506.
20. Kartikeyan K, Pushpanjali Prasad J. Soil fertility status of soybean (*Glycine max* L.) growing soils of Malwa plateau, Madhya Pradesh. J Indian Soc. Soil Sci. 2014; 62(2):170-178.
21. Kumar R, Sarkar AS, Singh KP, Agarwal BK, Karmakar S. Appraisal of available nutrients status in Santhal Paraganas region of Jharkhand. J Indian Soc. Soil Sci. 2009; 57(3):366-369.
22. Leelavathi P, Naidu MVS, Ramavatharam N, Karunsagar G. Genetics, classification and evaluation of soils for sustainable landuse planning in Yepedu Mandal of Chittoor district of Andhra Pradesh. Journal of theIndian society of soil Science. 2009; 57(2):109-120.
23. Lettens S, Orshoven V, Wesemael V, Perrin D, Roelandt C. The inventory-based approach for prediction of SOC changes following land use change. Biotechnology, Agronomy, Society and Environment. 2004; 8:141-146.
24. Liu XL, He YQ, Zhang HL, Schroder JK, Li CL, Zhou J *et al*. Impact of land use and soil fertility on distributions of soil aggregate fractions and some nutrients. Pedosphere. 2010; 20(5):666-673.
25. Malo DD, Schumacher TE, Doolittle JJ. Long-term cultivation impacts on selected soil properties in the northern Great Plains. Soil and Tillage Research. 2005; 81:277-291.
26. Mansha N, Lone FA. Effect of land use/land cover change on soils of a Kashmir Himalayan catchment-sindh. International Journal of Research in Earth and Environmental Sciences. 2013; 1:2311-2484.
27. Maqbool M, Rehman NZ, Rehana R, Akhtar F. Available macronutrient status of soil under different land use systems of district Ganderbal, Jammu and Kashmir, India. Journal of the Indian Society of Soil Science. 2017; 65(3):256-263.
28. Meena HB, Sharma PR, Rawat US. Status of macro-micronutrients in some soils of Tonk district of Rajasthan. J Indian Society of Soil Sci. 2006; 54:508-12.
29. Najar GR. Studies on paedogenesis and nutrient indexing of apple (Red Delicious) growing soils of Kashmir. Thesis submitted to SKUAST-Kashmir Srinagar, 2002, 204.
30. Najar GR, Akhtar F, Singh SR, Wani JA. Characterization and classification of some apple growing soils of Kashmir. Journal of the Indian Society of Soil Science. 2009; 57:81-84.
31. Negassa W. Assessment of Important Physicochemical Properties of Nitosols under Different Management Systems in Bako Area, Western Ethiopia. M.Sc. Thesis, Alemaya University, Alemaya, Africa, 2001, 109.
32. Nelson DW, Sommers IP. Total carbon, organic carbon and organic matter In: Page, A.L (ED), Methods of Soil Analysis: Part 2: Agronomy Handbook No 9. American Society of Agronomy and Soil Science Society of America, Madison. WI, 1986, 539-579.
33. Neris J. Vegetation and land-use effects on soil properties and water infiltration of Andisols in Tenerife. 2012; 98:55-62.
34. Olsen SR, Sommers LE. Phosphorus. In Methods of Soil Analysis, Part 2, Madison, Soil Science Society of America, 1982, 403-430.
35. Piper CS. Soil and Plant Analysis. Hans Publisher. Bombay, India, 1966.
36. Post W, Kwon K. Soil carbon sequestration and land-use change: processes and potentials. Global Change Biology. 2000; 6:317-327.
37. Regmi BD, Zoebisch MA. Soil fertility status of *bari* and *khet* land in a small watershed of middle hill region of Nepal. Nepal Agricultural Research Journal, 2004; 5:38-42.
38. Reijneveld A, Van Wensem J, Oenema O. Soil organic carbon contents of agricultural land in the Netherlands between 1984 and 2004. Geoderma. 2009; 152:231-238.
39. Sarkar D, Gangopadhyay SK, Velayutham M. Soil toposequence relationship and classification in lower outlier of Chhotanagpur plateau. Agropedology. 2001; 11:29-36.
40. Sathyavathi PLA, Reddy SM. Soil site suitability for six major crops in Telangana region of Andhra Pradesh. Journal of the Indian Society of Soil Science. 2004; 52(3):220-225.
41. Sharma PK, Sood A, Setia RK, Tur NS, Mehra D, Singh H. Mapping of macronutrients in soils of Amritsar district (Punjab) A GIS approach. J Indian Soc. Soil Sci. 2008; 56(1):34-41.
42. Singh RP, Mishra SK. Available macronutrients (N, P, K and S) in the soils of Chiraigaon Block of District Varanasi (U.P) in relation to soil Charecteristics. Indian J Sci. Res. 2012; 3(1):97-100.
43. Singh YV, Jat LK, Santosh K. Available Macro Nutrient Status and their Relationship with Soil Physico-Chemical Properties of Sri Ganganagar District of Rajasthan, India. J Pure and Appl. Microbiol. 2015; 9(4):2887-2894.
44. Somasundaram J, Singh RK, Parandiyal AK, Ali S, Chauhan VS, Nishant K *et al*. Soil Properties under different land use systems in parts of Chambal region of Rajasthan. J Agri. Physics. 2013; 13(2):139-147.
45. Subbiah BV, Asija GL. A rapid procedure for the estimation of available nitrogen in soils. Current Science. 1956; 25:259-260.
46. Swarnam TP, Velmurugan A, Rao YS. Characterisation and classification of some soils from Shaahibi basin in parts of Haryana and Delhi. Agropedology. 2004; 14:114-122.
47. Verma KS, Saxena RK, Bhargava GP. Anomalies in classification of the salt affected soil under USDA soil taxonomy. Journal of the Indian Society of Soil Science. 2007; 55(1):1-9.
48. Yihenew GS, Fentanesh A, Solomon A. Effects of land use types, management practices and slope classes on selected soil physico-chemical properties in Zikre Watershed, North-Western Ethiopia. Environmental Systems Research. 2015; 4:3
49. Yitbarek T, Gebrekidan H, Kibret K, Beyene S. Impacts of land use on selected physicochemical properties of soils of Abobo area, Western Ethiopia. Agriculture, Forest and Fisheries. 2013; 2: 177-183.