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Manashi Chakravarty
Assistant Professor, Soil Science, College of Horticulture and Farming System Research, Nalbari, Assam Agricultural University, Assam, India

Aradhana Barooah
Associate Professor, Soil Science, College of Horticulture and Farming System Research, Nalbari, Assam Agricultural University, Assam, India

Utpal Jyoti Sarma
Professor and Head, Krishi Vigyan Kendra, Baksa, Assam Agricultural University, Assam, India

Corresponding Author:
Manashi Chakravarty
Assistant Professor, Soil Science, College of Horticulture and Farming System Research, Nalbari, Assam Agricultural University, Assam, India

Soil fertility status of some villages of Nalbari district, Assam using nutrient index approach

Manashi Chakravarty, Aradhana Barooah and Utpal Jyoti Sarma

Abstract
A study was conducted to evaluate the fertility status of soils of twelve different villages of Pub Nalbari block of Nalbari district, Assam, India. A total of 300 numbers of surface soil samples (0-15 cm depth), comprising of 25 composite soil samples from each site, were collected. The collected soil samples were air dried, sieved and analyzed for different fertility parameters *viz*., soil pH, electrical conductivity, organic carbon, available nitrogen, available phosphorus, available potassium, available sulphur and available zinc and boron using standard procedures. Based on calculated nutrient index value soil fertility rating as low, medium and high for each fertility parameter was done. Results revealed that pH of the all soils of study area was found in the acidic range and majority (43%) of the samples lie in the very strongly acidic (4.5 to 5.0) range. Electrical conductivity was normal (<1dS/m). Soil organic carbon varied and recorded in low (15%), medium (57%) and high (28%) category. Nutrient index value for available nitrogen, phosphorus and potassium was low to medium range. Available sulphur was high to medium in the soils of the study area and zinc content was found low to but available boron was recorded low for most of the soil samples.

Keywords: Nutrient index, soil fertility, soil samples, micro nutrients, soil pH

Introduction
It is an established fact that soil fertility is an inherent capacity of soil to supply nutrients in adequate quantities to plants for proper growth and development and that is being influenced by various physical, chemical and biological properties of soil which are controlled by natural and human being factors. Healthy soil ensures quality food, nutritional security, and critical for achieving sustainable development goals but, there is a large gap between potential and farmers' harvested yield due to decreasing capacity of the soils to support soil functions. (Das *et al.*, 2022) [16]. Soil fertility is a prime factors that controls yields of the crops (Chandrakala *et al*., 2018) [14]. One of the major limitation for achieving higher productive yield, in India, is low fertility status of soil. (SLUSI, 2010) [37]. In agricultural soils the soil fertility may be depleted due to continuous cultivation (Ogunjinmi *et al*., 2017) [28] and intensive cultivation tremendously reduces secondary and micronutrients in soil (Amara *et al*., 2017) [2]. Moreover, agricultural management practices and climate change also changes the fertility of soil (Abdel Rahman *et al*., 2022) [1]. Depletion of soil fertility also results from indiscriminate use of chemical fertilizers, injudicious application of irrigation and different cropping practices (Medhe *et al.*, 2012) [26]. Soil erosion is a major pathway of soil degradation (Gupta *et al*., 2021) [18] and effects on soil fertility depletion through nutrient loss (Bashagaluke *et al*., 2018) [8]. Thus there is an increase in trend of land degradation and deterioration of soil health (Basak *et al.*, 2021) [4]. Use of chemical fertilizers without knowing the soil nutrient status and crop need may adversely affect the soil health as well as crop production (Ray *et al*., 2000) [33].
A fertile soil is rich in all availability of macro and micro nutrients with good soil aeration, water holding capacity and good soil texture that governs the high crop yield and sustain plant growth. (Bharti *et al*., 2017) [10]. For sustainable agricultural production, maintenance of soil fertility is crucial. Nutrient availability in soil depends on soil productivity and soil fertility is determined by the quantity of nutrients present in the soil. Soil fertility evaluation is the key for adequate and balanced nutrition of crops. Among various methods of soil fertility evaluation, soil testing is one of the better, precise and balanced method of soil fertility management. Macronutrients (N, P, K, and S) and Micro nutrients (Zn, Cu, Fe, Mn, and B) are essential soil elements that regulate soil fertility (Tarar *et al*., 2023) [40]. Based on Spatial variability in nutrient elements in soils estimated by soil testing can be successfully used for further fertilizer recommendation as well as input management as per need of the crops

(Motghare *et al*., 2020) [27]. Nutrient index approach can be used to evaluate the fertility status of the soil under different cropping sequence (Singh *et al*., 2018 [36], Barooah *et al.*, 2020) [5].

Nalbari district is located in central Western part of Assam is one of the agriculturally important district in Lower Brahmaputra Valley Zone of Assam lies between 26^0 N Latitude and 91^0 E Longitude with mean elevation 89 m above msl where 75% of the population depends on agriculture. Rice is the major crop and rice based cropping systems are predominantly practiced by the farmers. The present study site has been continuously cultivated year after year with improper management practices that involves imbalance and injudicious use of nutrients without knowing the soil fertility status, and removal of crop residues from field may lead to decline the soil organic carbon resulting decline in the productivity and sustainability of soil. However, information on soil fertility status are meagre in the study site, therefore, the present investigation was undertaken to assess the fertility status of different villages under Pub Nalbari Block of Nalbari district, Assam using fertility ratings and nutrient index approach for adoption of proper management practices to maintain soil health and crop productivity.

Materials and Methods

Soil samples were collected from twelve different villages *viz*., Kendukuchi ($26^0$27.708'N latitude to $091^0$28.779'E longitude), Chengnoi ($26^0$29.627' Nlatitude to $91^0$28.315'E longitude), NizBahjani ($26^0$28.920'N latitude to $091^0$30.272'E longitude), Khudrasankara ($26^0$23.119' N latitude to $091^0$24.174' E longitude) Porakuchi ($26^0$26.672'N latitude to $091^0$29.522'E longitude), Paikarkuchi ($26^0$26.417' N latitude to $091^0$29.498' E longitude), Sandha ($26^0$27.054' N latitude to $091^0$28.172' E longitude), Sariahtoli ($26^0$28.175'N latitude to $091^0$26.013' E longitude), Tantrasankara ($26^0$25.608' N latitude to $091^0$28.568' E longitude), Balikuchi ($26^0$25.434' N latitude to E$091^0$29.093'E longitude), Doukuchi ($26^0$23.174'N latitude to E$091^0$24.892'E longitude) and Guwakuchi ($26^0$25.879'N latitude to $091^0$29.825'E longitude) of Pub Nalbari Block of Nalbari district of Assam state, India. The climate of the study sites is basically sub-tropical in nature with warm and humid summer followed by cool and dry winter with an average annual rainfall of the district is 2029 mm. Temperature in winter ranges from 11°C to 23.2°C and summer temperature lies from 23.7°C to 35°C. (Source: Resource Inventory of Nalbari District). A total of 300 numbers of surface soil samples (0-15 cm depth) were collected from the twelve villages (25 numbers of samples from each village) with the help of core sampler and composite soil samples were prepared. All the composite soil samples were air dried at room temperature, ground and passed through 2 mm sieve and analyzed for different soil parameters *viz*., soil pH, electrical conductivity (EC), organic carbon, available nitrogen, available phosphorus, available potassium, available sulphur and micronutrients (available zinc and boron) by using standard analytical methods. Soil pH and electrical conductivity in 1:2.5 soil: water suspension were determined by potentiometric method using pH meter and Systronics Digital Electrical Conductivity meter respectively (Jackson, 1973) [23]. Titrimetric determination or wet digestion method of Walkley and Black (1934) [41] was used to determine organic carbon content of the soil samples. The soil samples were analyzed for macronutrients like available nitrogen and phosphorus by alkaline potassium permanganate method (Subbiah and Asija, 1956) [39] and Bray's I method (Bray and Kurtz, 1945) [12] respectively. Available potassium was determined by flame photometer with neutral normal ammonium acetate as an extractant (Hanway and Heidel, 1952) [20]. Available Sulphur content of the soil samples were determined by turbidimetric method (Black, 1965) [11]. Micronutrients *viz*., available zinc (DTPA extractable) was determined by using Atomic Absorption Spectrophotometer (Lindsay and Norvell, 1978) [25] and hot watersoluble boron was determined by using UVVIS Spectrophotometer (Wear, 1965) [42]. To assess the fertility status of the soil, Nutrient Index Value (NIV) approach introduced by Parker *et al* (1951) [29]and modified by Pathak (2010) [30], Kumar *et al* (2013) [24], Ravikumar and Somashekar (2013) [32] as below is followed:

$$NIV = (NL \times 1 + NM \times 2 + NH \times 3)/NT$$

Where, NL, NM and NH are per cent samples testing low, medium and high category, respectively and NT is total number of soil samples used for calculation.

Nutrient index values with respect to organic carbon, available N, P, K, S, Zn and B were used to categorize fertility statusof the soil as low, medium and high based on Nutrient index range (Table 1).

Table 1: Nutrient Index range and remarks

Nutrient index	Range	Remarks
I	Below 1.67	Low
II	1.67-2.33	Medium
III	Above 2.33	High

Results and Discussion

Soil pH

The result indicated that pH of the soils varied from 4.30 to 6.80 with mean value 5.42 (Table 2). The study showed that pH of the soils in all the villages were in the acidic range and out of 300 soil samples analysed, 43% of the samples were strongly acidic (pH 5.1-5.59) followed by 23.67% very strongly acidic(pH 4.5-5.0) range. Assam soil is basically acidic in reaction. The acidity of the study area might be due to leaching loss of basic cations from the soil surface because of high rainfall (Sathish *et al.*, 2017) [38]. Chakravarty *et al.*, (1987) [13] reported that old alluvial flood plains in Assam under high rainfall (> 2000 mm/year) soils are acidic having pH value 5. The result is in accordance with Barooah *et al.*, (2020) [5].

Electrical conductivity (EC)

The electrical conductivity (EC) varied from 0.01 to 0.47 $dSm^{-1}$with mean value of 0.073 dsm^{-1} (SD=±0.05). The EC of all the collected soil samples (100%) were found in normal (< 1.0 dSm^{-1}) category (Table 3). It indicated that there is no soil limitation for crop production from soluble salt concentration in soils of study area. Similar result was also reported, which might be attributed due to inherent factors like soil minerals, climate, soil texture and leaching of soluble salts due to excessive rainfall (Barooah *et al.*, 2020) [5].

Organic Carbon (OC)

Organic carbon content in soil ranged from 0.29 to 0.98% with mean value 0.67%. The result indicated that 57% soil samples was under medium category (0.5-0.75%) in organic carbon content, 28% under high (>0.75%) and remaining 15% samples fall under low category (<0.50%) (Table 3 and Fig1). The medium and low category organic carbon content may be ascribed due to lower rate of application of FYM and removal of crop residues as well as rapid rate of decomposition (Sathish *et al.*, 2017) [38].

Available Nitrogen (N)

The soil available nitrogen content of the study area ranged from 210.6 to 564.9 kg ha^{-1} with an average value of 351.10 kg ha^{-1} (Table 4). On the basis of the rating suggested by Baruah and Barthakur (1997) [6], majority of the samples (75%) found in medium (272 to 544 kg ha^{-1}) and remaining 20% of the samples in low (< 272 kg ha^{-1}) and 5% in high (> 544 kg ha^{-1}) category (Fig. 1). Soil management practices, application of FYM and fertilizer to previous crop may be related to variation in soil available N content (Ashok Kumar, 2000, Zou *et al*, 2018) [3, 43].

Available phosphorus (P)

Available phosphorus content in soils varied from 11.90 to 63.00 kg $ha^{-1}$with a mean value of 27.45 kg ha^{-1}(Table 4). Based on the limits suggested by Baruah and Barthakur (1997) [6], 35% of the samples were found in low (< 22.5 kg ha^{-1}), 63% in medium (22.5 to 56 kg ha^{-1}) and 2% in high (> 56 kg ha^{-1}) category (Fig 1). The variation of available phosphorus in soil might be mostly affected by previous fertilizer application, soil pH, soil organic matter content, soil texture, various soil management and agronomic practices (Balakrishna *et al*., 2017, [7] Tarar *et al*., 2023) [40]. Soils of the study area were mostly acidic in nature and there is a tendency of low soil phosphorus over time in acid soil as reported by Dutta *et al*., (2008) [17]. Results arein confirmative with the findings of Barooah *et al*., 2020 [5].

Available Potassium (K)

The content of available potassium of the present study area (Table 4) varied from 39.15 to 339.90 kg $ha^{-1}$with the mean content of 165.77 kg ha^{-1}available potassium. According to Baruah and Barthakur (1997) [6], most of the soil samples (46%) found under low (< 136 kg ha^{-1}) and remaining 49% samples under medium (136to 337.5 kg ha^{-1}) and 5% samples under high (> 337.5 kg ha^{-1}) range (Fig 1). The results indicated that application of potassic fertilizer is required for better crop growth and yield. This finding is in agreement with the earlier findings of Pulakeshi *et al.*, 2012, Barooah *et al.*, 2020[31, 5]. Earlier, Ghosh and Hasan, (1976) [19] reported low levels of potassium and Hasan and Tiwari, (2002) [22] reported medium range of potassium in Assam soil.

Available sulphur (S)

The available sulphur status of the study area varied from 4.98 to 66.4 mg $kg^{-1}$with mean value of 21.68 mg kg^{-1}(Table 4). According to the category given by Hariram and Dwivedi (1994), 19% of the samples were found under deficient (< 10 mg kg^{-1}), 38% samples in the medium category and 43% samples in the sufficient range (Fig 1).

Available Zinc (Zn)

Available zinc content of the study area ranges from 0.11 to 0.92 mg $kg^{-1}$with an average value of 0.45 mg kg^{-1}(Table 5). On the basis of the rating suggested by Baruah and Barthakur (1997) [6], most of the samples (78%) found in medium (0.3 to 2.3 mg kg^{-1}) range and only 22% of the samples in low (< 0.3 mg ha^{-1}) (Fig 1). It was recorded, that 76.67% of the analyzed soil samples are deficient (<0.6 mg kg^{-1}) in available zinc content and only 23.33% samples were sufficient (>0.6 mg kg^{-1}) category (Table 4). Zn deficiency in soils of Nalbari district was also reported by Reza *et al.*, (2021) [34] and it is positively correlated with soil organic carbon.

Available Boron (B)

In the study area, available boron content varied from 0.10 to 0.82 mg $kg^{-1}$with mean value of 0.39 mg kg^{-1} (Table 5). As per rating category of Berger and Truog (1939) [9], maximum number of soil samples (76.33%) of the study area remained in the deficient range (< 0.5 mg kg^{-1}) and remaining 23.76% samples were found under sufficient (> 0.5 mg kg^{-1}) category of available boron (Table 4). Out of the total sample analysed, 75% samples were low in available B content (<0.5 mg kg^{-1}) and 25% samples were in medium category (0.5-1.0 mg kg^{-1}) (Fig 1). Choudhari *et al.*, (2019) [15] reported highest deficiency of B in Lower Brahmaputra Zone of Assam. Low and medium range of available boron in the study site might be due to soil acidity and leaching loss due to excessive rainfall of the area.

Soil nutrient indices of study sites

Nutrient index value (NIV) is used to measure the nutrient supplying capacity of soils to plants (Singh *et al*., 2016). From the NIV calculated, the fertility status of the study area was categorized into low, medium and high ratings (Table 5). In the study area, nutrient index analysis revealed that organic carbon status varied from medium (NIV=1.67-2.33) to high (NIV >2.33). Out of the soils of 12 villages, the organic carbon status was found medium in the soils of 11 villages (Kendukuchi, Chengnoi, Khudrasankara, Porakuchi, Paikarkuchi, Sandha, Sariahtoli, Tantrasankara, Balikuchi, Doukuchi and Guwakuchi) except one village (Nizbahjani). Based on Nutrient Index Value, the fertility rating (FR) for available N, available P and available K varied from low to medium. Available N status was medium in Kendukuchi, Chengnoi, Nizbahjani, Porakuchi, Paikarkuchi, Sandha, Sariahtoli, Tantrasankara, Balikuchi, Doukuchi and Guwakuchi and low in Khudrasankara village. Likewise Available status of P was medium in Sahpur, Paikarkuchi, Sandha, Sariahtoli, Doukuchi, Khudrasankara and Guwakuchi and low in Kendukuchi, Nizbahjani, Porakuchi, Tantrasankara and Balikuchi. Available K was recorded lowin most of the villages (Kendukuchi, Chengnoi, Nizbahjani, Porakuchi, Tantrasankara, Doukuchi, Khudrasankaraand medium in Balikuchi, Paikarkuchi, Sandha, Sariahtoli and Guwakuchi. The available S status was recorded high to medium (Table 6). Available Zn status was also medium to low in the study area and available B was low i.e., deficient in 11 villages except Guwakuchi where medium status of available B was found (Table 6).

Table 2: Soil acidity class of different villages of study sites of Nalbari district

Village	Extremely acidic (<4.5)	Very strongly acidic (4.5-5.0)	Strongly acidic (5.1-5.59)	Medium acidic (5.6-6.0)	Slightly acidic (6.1-6.59)	Neutral (6.6-7.39)
Kendukuchi	0	28	44	16	12	0
Chengnoi	0	0	44	40	16	0
NizBahjani	0	12	52	16	20	0
Khudrasankara	0	16	36	28	20	0
Porakuchi	0	20	56	24	0	0
Paikarkuchi	0	64	36	0	0	0
Sandha	12	40	0	0	28	0
Sariahtoli	0	0	60	20	0	20
Tantrasankara	0	0	32	20	32	16
Balikuchi	0	16	68	16	0	0
Doukuchi	0	0	64	0	36	0
Guwakuchi	0	88	12	0	0	0

Table 3: Range and mean values of physico-chemical properties of soils of different villages

Village	pH		EC [Cmol(p+)kg^{-1}]		Organic carbon (%)	
	Range	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD
Kendukuchi	4.50 -6.35	5.45±0.49	0.01-0.03	0.03±0.02	0.55-0.78	0.63±0.07
Chengnoi	5.20 -6.50	5.65±0.41	0.02-0.62	0.13±0.17	0.42-0.80	0.65±0.13
NizBahjani	4.94-6.20	5.53±0.38	0.05-0.20	0.07±0.03	0.62-1.09	0.78±0.16
Khudrasankara	4.90-6.42	5.51±0.48	0.01-0.47	0.13±0.14	0.40-1.61	0.79±0.41
Porakuchi	4.80-6.00	5.27±0.34	0.01-0.15	0.07±0.04	0.44-1.07	0.80±0.29
Paikarkuchi	4.60-5.10	4.90±0.19	0.05-0.21	0.12±0.07	0.38-0.83	0.67±0.11
Sandha	4.30-6.20	5.25±0.81	0.02-0.07	0.04±0.02	0.29-0.98	0.61±0.18
Sariahtoli	5.20-6.70	5.72±0.58	0.02-0.07	0.05±0.02	0.29-0.85	0.64±0.16
Tantrasankara	5.20-6.80	5.90±0.60	0.02-0.07	0.04±0.02	0.35-0.87	0.61±0.15
Balikuchi	4.80-6.40	5.41±0.40	0.04-0.09	0.06±0.02	0.44-0.91	0.71±0.13
Doukuchi	5.10-6.40	5.64±0.54	0.03-0.07	0.05±0.01	0.39-0.81	0.61±0.10
Guwakuchi	4.59-5.44	4.86±0.26	0.02-0.14	0.08±0.04	0.39-0.81	0.59±0.14
Average Range and Mean ± SD	4.30-6.80	5.42±0.46	0.01-0.47	0.073±0.05	0.29-0.98	0.67±0.17

Table 4: Range and mean values of macro nutrients (available N, P, K and S) of soils of different villages

Village	Available N (kg ha^{-1})		Available P (kg ha^{-1})		Available K ((kg ha^{-1})		Available S (mg kg^{-1})	
	Range	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD
Kendukuchi	356 -435	412.46±18.17	16.70-63.00	26.01±13.03	46.80-219.09	101.34±40.51	7.00-51.00	24.56±14.20
Chengnoi	207 -423	307.19±65.05	15.90-47.60	27.74±7.87	90.29-165.10	132.08±22.73	7.60-41.00	20.34±10.58
NizBahjani	274.4 -391.1	321.89±35.85	17.87-50.09	23.85±7.87	40.89-165.10	118.17±27.97	6.20-28.76	16.14±5.89
Khudrasankara	218.8 -519	316.62±102.09	11.90-37.50	27.92±7.62	39.15-282.05	134.47±83.66	4.98-21.50	13.52±5.71
Porakuchi	229 -541.2	319.65±72.26	14.30-35.70	23.75±6.39	90.20-216.00	150.95±46.84	7.60-23.90	13.37±4.55
Paikarkuchi	256.98 -545.00	348.28±69.06	19.70-56.50	27.44±8.04	61.91-343.10	220.35±71.83	7.50-40.00	21.07±9.81
Sandha	210.94 -564.98	373.65±98.06	14.32-57.09	36.16±11.32	123.40-232.70	196.68±34.77	6.40-25.09	13.11±6.15
Sariahtoli	210.6 -549.55	387.53±97.88	15.57-56.98	32.41±9.83	54.34-342.98	202.57±90.22	19.40-66.40	38.42±13.66
Tantrasankara	214.98 -548.90	362.25±98.35	13.40-34.60	21.00±6.70	54.98-338.87	177.78±90.10	7.70-64.10	32.05±22.94
Balikuchi	208.90 -512.11	344.19±78.76	22.13-4.36	0.06±0.02	100.08-339.09	201.80±87.32	9.30-17.30	11.47±2.40
Doukuchi	135.70 -545.00	311.19±125.54	21.30-46.40	31.03±6.88	87.50-337.75	172.65±78.42	11.16-53.90	29.20±11.07
Guwakuchi	212.09 -546.98	408.28±99.78	15.30-51.20	30.08±9.36	52.98-337.75	180.35±96.94	9.87-48.00	26.95±11.68
Average Range and Mean ± SD	210.6-564.9	351.1±80.07	11.9-63.0	27.45±8.27	39.15-339.9	165.77±61.95	4.98-66.4	21.68±10.64

Table 5: Range and mean values of micro nutrients (available Zn and B) of soils of different villages

Village	Available Zn (mg kg^{-1})		Per cent samples fall under		Available B (mg kg^{-1})		Per cent samples fall under	
	Range	Mean ± SD	Deficient (< 0.6)	Sufficient (> 0.6)	Range	Mean ± SD	Deficient (< 0.5)	Sufficient (> 0.5)
Kendukuchi	0.40 -0.80	0.58±0.17	60	40	0.25-0.60	0.40±0.14	72	28
Chengnoi	0.32 -0.58	0.39±0.10	88	12	0.31-0.49	0.40±0.06	92	8
NizBahjani	0.22 -0.76	0.41±0.17	76	24	0.10-0.55	0.25±0.14	88	12
Khudrasankara	0.12-0.92	0.43±0.28	80	20	0. 11-0.82	0.34±0.21	84	16
Porakuchi	0.30 -0.77	0.49±0.15	68	32	0.16-0.65	0.38±0.17	64	36
Paikarkuchi	0.21-0.74	0.46±0.16	80	20	0.16-0.71	0.37±0.14	84	16
Sandha	0.11 -0.67	0.43±0.18	72	28	0.11-0.61	0.29±0.11	76	24
Sariahtoli	0.16 -0.68	0.34±0.16	88	12	0.22-0.65	0.43±0.11	76	24
Tantrasankara	0.19 -0.65	0.40±0.13	92	8	0.22-0.59	0.42±0.10	72	28
Balikuchi	0.21 -0.91	0.50±0.18	68	32	0.20-0.76	0.42±0.15	80	20
Doukuchi	0.22 -0.69	0.42±0.15	88	12	0.22-0.54	0.40±0.09	80	20
Guwakuchi	0.21 -0.87	0.56±0.17	60	40	0.34-0.80	0.53±0.12	48	52
Average range and Mean ± SD	0.11-0.92	0.45±0.17			0.10-0.82	0.39±0.13		

Table 6: Soil fertility status of the study area

Village		OC (%)	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)	Available S (kg/ha)	Available Zn (mg/kg)	Available B (mg/kg)
Kendukuchi	NIV	2.12	2.00	1.48	1.20	2.76	2.00	1.28
	FR	Medium	Medium	Low	Low	High	Medium	Low
Chengnoi	NIV	2.28	1.68	1.80	1.48	2.20	1.92	1.08
	FR	Medium	Medium	Medium	Low	Medium	Medium	Low
NizBahjani	NIV	2.44	2.00	1.40	1.16	2.16	1.76	1.12
	FR	High	Medium	Low	Low	Medium	Medium	Low
Khudrasankara	NIV	2.12	1.44	1.76	1.40	1.80	1.52	1.16
	FR	Medium	Low	Medium	Low	Medium	Low	Low
Porakuchi	NIV	2.32	1.92	1.48	1.56	1.96	2.00	1.36
	FR	Medium	Medium	Low	Low	Medium	Medium	Low
Paikarkuchi	NIV	2.04	1.84	1.80	2.00	2.28	1.80	1.16
	FR	Medium	Medium	Medium	Medium	Medium	Medium	Low
Sandha	NIV	2.08	1.92	1.92	1.84	1.68	1.83	1.24
	FR	Medium	Medium	Medium	Medium	Medium	Medium	Low
Sariahtoli	NIV	2.12	1.92	1.84	1.88	2.92	1.40	1.24
	FR	Medium	Medium	Medium	Medium	High	Low	Low
Tantrasankara	NIV	2.36	2.04	1.32	1.56	2.12	1.80	1.28
	FR	Medium	Medium	Low	Low	Medium	Medium	Low
Balikuchi	NIV	2.36	1.84	1.52	1.76	1.72	1.84	1.20
	FR	Medium	Medium	Low	Medium	Medium	Medium	Low
Doukuchi	NIV	1.92	1.68	1.96	1.52	2.76	1.72	1.20
	FR	Medium	Medium	Medium	Low	High	Medium	Low
Guwakuchi	NIV	1.80	1.96	1.80	1.60	2.64	2.76	1.68
	FR	Medium	Medium	Medium	Low	High	High	Medium

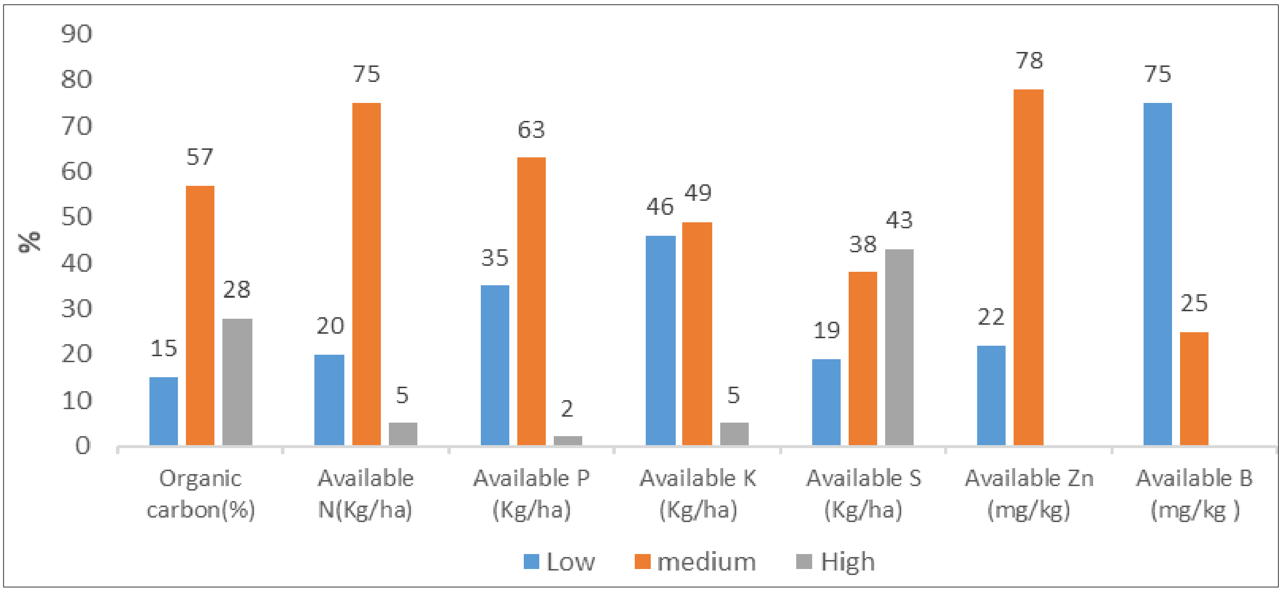

Fig 1: Soil fertility status of the study area

Conclusion

In can be concluded from the study, that soils of all the villages of the study area was acidic in reaction with normal electrical conductivity and soil organic carbon in majority of the soils was in medium range. Available nitrogen, phosphorus and potassium were found in low to medium category. On the contrary, available Sulphur was high to medium in the soils of the study area. The availability of micronutrients i.e., available Zinc was found in medium to low range and available Boron was in low range. Therefore, appropriate nutrient management practices including application of balanced organic and inorganic nutrients, green manuring, inclusion of legume crops in crop sequences, crop residue incorporation, proper cropping system and adequate agronomic practices are essential to enhance the soil fertility as well as for sustainable crop production in the area.

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