J. Soils and Crops 36 (1) 94-98, June 2026

ISSN 0971-2836 (Print)
ISSN 2582-2756 (Online)

ASSESSMENT OF FERTILITY STATUS OF AGRICULTURAL SOIL IN SOME VILLAGES OF GHOGRAPAR REVENUE CIRCLE, NALBARI DISTRICT, ASSAM

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ABSTRACT

The present study was designed to assess the fertility status of agricultural soils in some villages of Ghograpar revenue circle of Nalbari district. A total 120 numbers surface soil samples (0-15 cm depth) from eight villages, comprising 15 composite from each site were collected during the period of 2022-2023. The various important physico-chemical parameters of soil such as pH, electrical conductivity (EC), organic carbon (OC), available nitrogen (Av N), available phosphorus (Av P), available potassium (Av K), and available sulphur (Av S) were estimated by applying standard analytical procedure. The entire sampling sites of the study area were acidic in nature and the pH varied from 5.52 to 6.01. The electrical conductivity was found to be normal (< 1 ds m^{-1}). Further soil had medium to high organic carbon ranging from 0.55 to 0.92 %. The status of available N, P and K were observed in the range of 230.05 to 515.85 kg ha^{-1}, 20.84 to 49.16 kg ha^{-1} and 97.79 to 276.65 kg ha^{-1} respectively. Moreover soils had medium to high amount of available S with the range of 13.9 to 71.8 mg kg^{-1}. Again in terms of nutrient index value the fertility ratting with respect to OC, Av N, Av P, Av K and Av S were recorded as medium to high, medium, low to medium, low to medium and medium to high respectively.

(Key words: Nutrient, Ghograpar, fertility, parameters, physico-chemical)

INTRODUCTION

Soil is one of the vital component in biosphere and it has significant role in the life of every living organism on the planet (John *et al*., 2021). Regarding the controlling of crop yield, soil fertility plays an important role and for evaluation of soil fertility in particular region or area, soil characterization is an essential aspect in terms of sustainable production. Various factors including socio-economic condition, ecological balance, parent material, natural outputs inputs and management practices control the soil fertility (Thombe *et al*., 2020). The deterioration of soil fertility is also responsible due to soil erosion through run off and sediment. The determination of soil fertility is very important to supply nutrients for favorable development of crops (Sahoo *et al*., 2015). Imbalanced application of fertilizers without knowledge of fertility status crop needs may severely impacts the soil health as well as crop productivity (Ray *et al*., 2000). The estimation of soil productivity is connected with both physical as well as nutrient status (Jibhakate *et al*., 2009). In Assam, the deterioration of soil quality is serious problem for higher productivity of crop. Ghograpar revenue circle is one of the major revenue circle of Nalbari district, Assam. It is situated in the eastern part of the district. Rice, mustard oil, vegetables are major crops in this area. Without any prior knowledge of nutrient status of soil, the farmers applied lots of chemical fertilizers which directly impacts on quality of soil and environment.

However, the entire study area is still lacking of detail information of fertility status. The proper knowledge of soil fertility is very much helpful for maintain of soil health in addition to increase of productivity. Again it is very essential for assessing and monitoring of various soil fertility parameters of Ghograpar revenue circle of Nalbari district for implementation of suitable strategies to sustain the agriculture production. Therefore, present study attempted to estimate the fertility status of agriculture soil in the region specially Ghograpar revenue circle of Nalbari district, Assam. The findings of results may help to farmers and locality of entire region to know about fertility status of soil and to adopt necessary step for enhancing the productivity of crops.

MATERIALS AND METHODS

Study site

Nalbari district lies between 20^0 N latitude and 91^0 E longitudes. The climate of the site is warm humid in summer followed by cool in winter. The average rainfall of the district is about 2050 mm. Range of temperature in both winter and summer seasons varied from 17^0C to 25.2^0C and 23.7^0C to 36^0C respectively. There are seven revenue circle of Nalbari district. Ghograpar revenue circle is situated in the eastern

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part of the district. As per the census India, 2011, the population of the revenue is 90376. The geographical area of the circle is 186.93 square kilometers and 15404.55 hectares comprises total cropped area (Anonymous, 2022).

Sample collection

Soil samples were collected from eight different villages after harvesting the crop during the period of 2022-2023. These eight villages were Akana, Ponor kaunia,Sathamo, Japjapkuchi, Kayakuchi, Dalua, Nilpur, and Dihjari.

In the present investigation 120 numbers of soil samples were collected from eight villages with the help of core sampler. From each village 15 numbers of samples were collected. During the collection of samples, composite samples were prepared. To obtain a composite sample, 10-15 different soil samples were collected randomly and mixed thoroughly. The prepared composite soil samples were air dried at room temperature and proceed through 2 mm sieve and preserved in colorless polythene bags for analyzing eight number of various physico-chemical parameters *viz*., soil pH, EC, OC, available N, available P, available K and available S. All physico-chemical parameters were analyzed according to standard procedure. The pH was determined by using method followed by Piper (1950) and electrical conductivity was recorded as per method detailed by Jackson (1973) and organic carbon by Walkley and Black (1934). Available N was determined by alkaline potassium permanganate method (Subbiah and Asija, 1956), available P by Bray s method (Bray and Kurtz, 1951), available K by neutral ammonium acetate method (Black, 1965). Available S was determined by Tribidimetric method (Chesnin and Yien, 1950).

Nutrient Index value (NIV) was designed by Parkar *et al.* (1951) and it was modified by Ravikumar and Somashekar (2013) and this is followed according to following formula

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

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

Maximum, minimum, mean and standard deviation were determined for statistical analysis in all soil samples (Gupta, 2023).

RESULTS AND DISCUSSION

Physico chemical properties of soil

Soil p^H

In the present study, pH of soil samples varied from 5.52 to 6.01 with the mean value of 5.49. Soil samples in all villages were observed acidic in nature. The data presented in Table 1 showed that the maximum and minimum value was observed in the villages of Sathamo and Dalua with average value of 5.72 and 5.24 respectively. Similar type of results were reported by Baishya and Thakuria (2024), they reported that the pH of soil samples varied from 4.84 to 5.85 in paddy cultivated soils of Barbhag revenue circle of Nalbari district of Assam. The utilization of long term inorganic fertilizer in place of green manure, farmyard manure and rice straw residues has proved in lowering of pH (Tiwari, 2003). Barooah *et al.* (2020) also reported the acidity of soil with ranging of pH from 4.3 to 6.3 in some villages of Dibrugarh district of Assam.

Electrical conductivity

The EC content in our investigation varied from 0.12 to 0.33 ds m^{-1} with the mean value of 0.21 ds m^{-1}(Table 1). The maximum and minimum values were observed in the village of Kayakuchi and Dihjari with the average value of 0.31 and 0.09 ds m^{-1}. If the EC < 1 ds m^{-1}, then soil is free from salt. So from our result it was found that soil samples in all villages showed negligible effect of salinity. Similar type of results were earlier reported by Bhuyan *et al*. (2021), who recorded that the EC content varied from 0.25 to 0.79 ds m^{-1} with the average value of 0.54 ds m^{-1} in the soils of Biswanath district, Assam. The low conductivity of soil is responsible due to removal of soluble salts by high rainfall and other integral factors like soil minerals, climate and soil texture (Barooah *et al*., 2020).

Organic Carbon

From the Table 1, it was observed that the amount of organic carbon varied from 0.55 to 0.92 % with the average value of 0.76 %. According to Baruah and Barthakur (1997) rating, it was found that 60% soil samples were under medium category, 30% under high (> 0.75%) and remaining 10 % falls under low category (< 0.50 %). Identical type of results were observed by Baishya and Thakuria (2025), who reported that the amount of organic carbon varied from 0.53 to 0.85 % in the soils of Barbhag revenue circle of Nalbari district of Assam. High density of root weight, tissue of organic root and frequent addition of crop residue are some prime factors which contributes medium to high status of organic carbon in soils (Behra and Shukla, 2015).

Available N

The data presented in Table 2 was reported that the available N ranged from 230.05 to 515.85 kg ha^{-1} with the mean value of of 346.19 kg ha^{-1}. Based on limitation suggested by Baruah and Barthakur (1997), it was observed that 90% soil samples found under medium (272 to 544 kg ha^{-1}) and 10% under low category (< 272 kg ha^{-1}). The highest and lowest value was observed in the villages of Dalua and Kayakuchi with the average value of 378.19 and 281.91 kg ha^{-1} respectively of the study area. Similar type of results were reported by Barooah *et al*. (2020), who observed that the content of available nitrogen ranged from 176.98 to 576.90 kg ha^{-1} with the mean value of 325.1 kg ha^{-1} in the soils of Dibrugarh district of Assam. Various soil management practices, utilization of farmyard manure and application of fertilizer in previous crops are some major reasons for variation of available nitrogen in soils (Ashok, 2000).

Available P

From the Table 2, it was revealed that the concentration available phosphorus varied from 20.84 to 49.16 kg ha^{-1} with the average value of 35.56 kg ha^{-1} of the sampling sites. On the basis of ratting suggested by Barua and Barthakur (1997), it was observed that, 54% of samples were obtained in medium range (22.5 to 56 kg ha^{-1}), 30 % in low (< 22.5 kg ha^{-1}) and remaining 16 % in high category (> 56 kg ha^{-1}). The highest value was recorded in village of Nilpur with the mean value of 45.91 kg ha^{-1}. Similarly the lowest value was observed in village of Sathamo with the average value of 22.17 kg ha^{-1}. Sampling sites were acidic in nature, so it posed low tendency to absorb phosphorus from soil. These types of results were earlier reported by Basumutary *et al.* (2019), who reported that the available phosphorus varied from 9.5 to 62.5 kg ha^{-1} with the mean value of 32.4 kg ha^{-1} in the soils of Dhubri district, Assam. Soil acidity may contributes low to medium level of available phosphorus as it fixes phosphorus into unavailable form by iron and aluminum phosphate (Chakravarty *et al*.,2023).

Available K

The concentration of available potassium varied from 97.79 to 276.65 kg ha^{-1} with the average value of 185.86 kg ha^{-1} in the study area. According to Baruah and Barthakur (1997) rating, 47% of soil samples were found under low (< 136 kg $ha^{-1)}$, 40% samples under medium (136 to 337.5 kg ha^{-1}) and 13% samples under high category. From the Table 3, it was observed that the highest and lowest values were recorded in the village of Dihjari and Ponar kaunia with the mean value of 240.77 kg ha^{-1} and 140.78 kg ha^{-1} respectively. Identical type of results were reported by Bhuyan *et al*.(2021), who recorded that the concentration of available K ranged from 49.10 to 398.36 kg ha^{-1} with the mean value of 169.39 kg ha^{-1} in the soils of Biswanath district, Assam. Injudicious application of NPK fertilizers, low utilization of potash fertilizers and intensive cropping causes the low to medium level of available K in soils (Naidu *et al*., 2011).

Available S

The status of available S in our investigation ranged from 12.91 to 44.9 mg kg^{-1} with the mean value 32.31 mg kg^{-1} (Table 3). As per rating category by Hariram and Dwevedi (1994), 14% of samples were found under deficient (< 10 mg kg^{-1}), 53 % samples in the medium range (10 to 22 mg kg^{-1}) and remaining 33% samples under sufficient range. The data presented in Table 3 observed that the maximum and minimum values were recorded in villages of Nilpur and Akana with average value of 43.98 and 25.03 mg kg^{-1}. The low concentration of available sulfur in soil is attributed due to intensive cropping without sulphur fertilization (Patra *et al.,* 2012). Moreover, the imbalanced application of sulphur containing fertilizers contributes high range of sulphur in soils (Chakravarty *et al*.,2023).

Soil fertility index of study area

The overall fertility rating was determined on the basis of Nutrient index value. The fertility rating was categorized as low, medium and high on the basis of NIV which was presented in the Table 4. When the NIV is less than 1.67 then the fertility rating is low. The medium fertility rating is considered, when the value lies between 1.67 and 2.33. Similarly, if the value is more than 2.33 then the fertility rating is considered as high. Out of eight villages, the fertility rating of organic carbon was found medium in the soils of six villages (Akana, Ponar kaunia, Sathamo, Kayakuchi, Japjapkuchi and Nilpur) and high in remaining two villages (Dalua and Dihjari). The fertility rating with respect to available N was recorded as medium in all villages of the study area. Similarly the status of available P was observed as medium in the villages of Akana, Japjapkuchi, Kayakuchi, Nilpur, Dihjari and Dalua, whereas low rating was observed in the villages of Ponar kaunia and Sathamo. Again medium fertility rating was observed in the villages of Japjapkuchi, Kayakuchi, Nilpur, Dalua, Dihjari in connection with available K, and low rating was recorded in the villages of Akana, Ponar kauniua and Sathamo. Moreover the fertility rating with respect to available S was recorded as high in the villages of Dalua, Nilpur and Dihjari, whereas in rest of five villages including Akana, Ponar kaunia, Sathamo, Jaspjapkuchi and Kayakuchi exhibited medium rating.

The present investigation indicated that the soil of all villages exhibited acidic in reaction with non-saline in nature. The status of organic carbon and available S were found as medium to high in all soil sampling sites. Similarly the available P and available K were found as low to medium range. However, the status of available N was recorded as medium range in all sites. The fertility rating with respect to OC, Av N, Av P, Av K and Av S were recorded as medium to high, medium, low to medium, low to medium and medium to high respectively. So from this observation it can be predicted that the availability of major nutrients was not satisfactory in most of the villages. Therefore, different kinds of suitable soil management practices including utilization of balanced fertilizer, application of organic manure, emphasis of biofertilisers and adopting of appropriate cropping systems are very much essential for enhancing fertility status as well as for optimum crop productivity.

Table 1. Range and mean value of physico-chemical properties of soil of different villages

Village	pH		EC (dS m^{-1})		OC (%)	
	Range	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD
Akana	5.01-5.76	5.52 ± 0.39	0.14-0.39	0.25 ± 0.03	0.36-0.82	0.71± 0.61
Ponar Kaunia	5.13-6.14	5.50 ± 0.33	0.09-0.24	0.15 ± 0.09	0.40-0.88	0.68± 0.49
Sathamo	5.17-6.09	5.72 ± 0.21	0.13-0.34	0.22 ± 0.07	0.37-0.79	0.66± 0.38
Japjapkuchi	5.02-6.21	5.37 ± 0.36	0.13-0.49	0.24 ± 0.08	0.61-1.02	0.84± 0.31
Kayakuchi	4.98-5.95	5.43 ± 0.32	0.21-0.49	0.31 ± 0.27	0.38-0.75	0.63± 0.25
Dalua	5.13-6.12	5.24 ± 0.19	0.11-0.28	0.18 ± 0.19	0.64-1.04	0.87± 0.27
Nilpur	5.06-5.97	5.53 ± 0.21	0.17-0.29	0.20 ± 0.08	0.71-1.05	0.85± 0.19
Dihjari	4.87-5.82	5.61 ± 0.29	0.02-0.17	0.09 ± 0.04	0.55-1.08	0.86± 0.23
Average range and mean ± SD	5.52-6.01	5.49 ± 0.27	0.12-0.33	0.21 ± 0.01	0.55-0.92	0.76± 0.34

Table 2. Range and mean value of macro-nutrients (available N and P) of soils of different villages

Village	Available N(kg ha^{-1})		Available P(kg ha^{-1})	
	Range	Mean + SD	Range	Mean + SD
Akana	210.72-515.31	336.17 ± 70.28	17.30-46.28	37.06 ± 13.08
Ponar Kaunia	219.35-508.23	361.07 ± 70.12	20.29-50.09	29.28 ± 11.74
Sathamo	189.33-468.33	324.23 ± 69.18	11.19-40.25	22.17 ± 10.29
Japjapkuchi	255.27-537.03	373.88 ± 84.59	26.90-55.27	41.26 ± 9.86
Kayakuchi	198.23-463.22	281.49 ± 66.07	23.82-44.76	34.04 ± 8.32
Dalua	280.52-545.34	378.91 ± 80.29	16.91- 45.93	39.19 ± 9.58
Nilpur	267.66-559.95	364.52 ± 80.62	29.18- 58.48	45.91 ± 10.37
Dihjari	220.85-523.72	349.26 ± 64.17	21.17-52.28	41.91 ± 11.72
Average range and Mean ± SD	230.05-515.85	346.19 ± 73.16	20.84-49.16	35.56 ± 10.54

Table 3. Range and mean value of macro-nutrients (Available K and S) of soils of different villages

Village	Available K(kg ha^{-1})		Available S(mg kg^{-1})	
	Range	Mean + SD	Range	Mean + SD
Akana	102.34-252.13	151.30 ± 47.88	8.9-40.29	25.03 ± 10.08
Ponar Kaunia	80.26-217.07	140.78 ± 57.28	12.3-41.62	30.54 ± 19.23
Sathamo	79.16-234.06	164.52 ± 40.27	9.5-41.17	29.14 ± 19.28
Japjapkuchi	120.57-302.92	206.92 ± 60.97	16.8-49.55	30.2 ± 20.63
Kayakuchi	70.92-234.56	172.92 ± 48.62	20.2-38.07	29.03 ± 12.9
Dalua	97.65-265.08	194.35 ± 50.36	13.4-50.55	38.28 ± 19.26
Nilpur	119.02-348.65	215.32 ± 65.19	11.7-57.06	43.98 ± 28.29
Dihjari	112.46-357.86	240.77 ± 70.16	18.7-41.04	31.64 ± 24.05
Average range and Mean ± SD	97.79-276.65	185.86 ± 55.06	12.9-44.91	32.3 ± 19.21

Table 4. Soil fertility status of the study area

Village		OC(%)	Available N (kg ha^{-1})	Available P (kg ha^{-1})	Available K (kg ha^{-1})	Available S (mg kg^{-1})
Akana	NIVFR	2.17 Medium	2.08 Medium	1.94 Medium	1.59 Low	1.83 Medium
Ponar Kaunia	NIVFR	2.01 Medium	1.98 Medium	1.65 Low	1.51 Low	1.98 Medium
Sathamo	NIVFR	1.95 Medium	2.12 Medium	1.63 Low	1.64 Low	1.90 Medium
Japjapkuchi	NIVFR	2.25 Medium	2,23 Medium	1.98 Medium	1.98 Medium	2.03 Medium
Kayakuchi	NIVFR	1.90 Medium	2.03 Medium	2.07 Medium	1.85 Medium	1.94 Medium
Dalua	NIVFR	2.37 High	2.27 Medium	2.12 Medium	1.80 Medium	2.40 High
Nilpur	NIVFR	2.23 Medium	2.20 Medium	2.20 Medium	2.09 Medium	2.48 High
Dihjari	NIVFR	2.36 High	2.09 Medium	2.14 Medium	2.17 Medium	2.35 High

(NIV- Nutrient Index Value, FR- Fertility Rate)

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Rec. on 01.01.2026 & Acc. on 17.01.2026