Plant Archives Vol. 26, No. 1, 2026 pp. 1187-1194 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2026.v26.no.1.161

EVALUATION OF SOIL FERTILITY STATUS OF AMALIPADAR VILLAGE OF GARIABAND DISTRICT, CHHATTISGARH INDIA

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(Date of Receiving-24-01-2026; Date of Revision-18-03-2026; Date of Acceptance-31-03-2026)

ABSTRACT

A study was conducted during 2023–24 to assess the soil fertility status of agricultural lands in Amalipadar Village, located in Chhattisgarh. The primary objective was to evaluate the macro- and micronutrient status of soils and develop nutrient management recommendations for improving crop productivity. A total of 160 surface soil samples (0-15 cm) were collected from farmer's fields and analyzed using standard laboratory procedures. Soil physico-chemical properties, including pH, electrical conductivity (EC), and organic carbon, along with available macronutrients and micronutrients, were determined and interpreted using the Nutrient Index Value (NIV) approach. The soil pH ranged from 6.02 to 7.91 with a mean value of 6.60, indicating slightly acidic to neutral reaction. Electrical conductivity varied from 0.05 to 0.23 dS m^{-1} (mean 0.14 dS m^{-1}), suggesting absence of salinity hazards. Organic carbon content ranged from 2.17 to 7.59 g kg^{-1} with an average of 5.84 g kg^{-1}. Available nitrogen ranged from 125.44 to 275.9 kg ha^{-1} (mean 209.87 kg ha^{-1}), phosphorus from 4.25 to 37.95 kg ha^{-1} (mean 16.61 kg ha^{-1}), and potassium from 112.23 to 553.10 kg ha^{-1} (mean 284.95 kg ha^{-1}). Available sulphur content varied between 1.26 and 35.53 kg ha^{-1} with a mean of 24.83 kg ha^{-1}. DTPA-extractable micronutrient analysis showed that iron (6.26–37.67 mg kg^{-1}; mean 14.71 mg kg^{-1}), manganese (3.57–21.45 mg kg^{-1}; mean 6.78 mg kg^{-1}), and copper (1.00–2.90 mg kg^{-1}; mean 1.54 mg kg^{-1}) were generally sufficient. However, zinc levels (0.25–0.41 mg kg^{-1}; mean 0.27 mg kg^{-1}) were deficient in all sampled soils. The results highlight the need for balanced fertilization with special emphasis on zinc supplementation to enhance soil fertility and sustain crop productivity in the region.

***Key words*:** Soil fertility status, nutrient index value (NIV), physico-chemical properties, Zinc deficiency

Introduction

Soil fertility assessment is a fundamental tool for evaluating the nutrient status of soils and plays a crucial role in achieving sustainable agricultural production. It provides essential information for optimizing nutrient management strategies, thereby enhancing crop productivity and maintaining soil health. Imbalanced and inadequate nutrient supply is one of the major constraints limiting agricultural productivity and farm income worldwide. Continuous nutrient mining due to intensive cropping, coupled with insufficient or inappropriate fertilizer application, leads to a gradual decline in soil fertility (Lal, 2009).

In many agricultural systems, removal of crop residues, which can account for up to 70–90% of total biomass, further exacerbates nutrient depletion and reduces soil organic matter content. Additionally, monocropping practices and the absence of adequate soil conservation measures contribute to soil degradation and reduced nutrient-use efficiency (FAO, 2015). Improper timing and method of manure and fertilizer application may also result in nutrient losses, toxicity, or deficiencies, adversely affecting both soil fertility and crop growth. Sustainability in agriculture is closely linked to the maintenance of soil, water, and environmental quality. Among the various factors influencing sustainability, the judicious use of fertilizers is paramount. With increasing global population pressure, the demand for food production has intensified, leading to excessive reliance on high-analysis chemical fertilizers. However, indiscriminate use of these inputs often results in nutrient imbalances, soil acidification, and environmental pollution, posing a serious challenge to sustainable agriculture (Tilman *et al*., 2002).

To address these challenges, site-specific nutrient management (SSNM) has emerged as an effective approach for improving nutrient-use efficiency and sustaining soil fertility. SSNM involves the application of nutrients based on spatial and temporal variability in soil nutrient supply and crop demand. Conventional fertilizer recommendations are often generalized over large regions, ignoring field-level variability, which may lead to over- or under-application of nutrients in different areas (IRRI, 2013). The SSNM approach aims to synchronize nutrient application with crop requirements, thereby enhancing nutrient uptake efficiency, minimizing losses, and improving crop productivity. It also reduces input costs and environmental impacts by avoiding excessive fertilizer use. Studies have shown that SSNM can increase crop yields by more than 10–15% while reducing overall nutrient inputs, ultimately improving farm profitability and sustainability (IPNI, 2012).

In addition to SSNM, integrated nutrient management (INM), which combines organic manures, crop residues, and inorganic fertilizers, has been recognized as a sustainable approach for maintaining long-term soil fertility and productivity. The integration of organic and inorganic nutrient sources not only improves soil physical, chemical, and biological properties but also enhances nutrient availability and use efficiency. Long-term experiments have demonstrated that balanced fertilization along with organic amendments significantly improves soil organic carbon, microbial activity, and crop yields compared to sole reliance on chemical fertilizers (ICAR, 2018; Ramesh *et al*., 2005). Furthermore, advances in precision agriculture technologies, including remote sensing, geographic information systems (GIS), and decision support tools, have strengthened the implementation of SSNM by enabling real-time monitoring of soil and crop conditions. These tools facilitate precise nutrient application, reduce environmental risks, and enhance resource-use efficiency. Therefore, combining soil fertility assessment with SSNM and modern precision tools offers a robust pathway toward sustainable and climate-resilient agriculture.

Table 1: Soil fertility rating according to NIV classes (for N, P and K).

Nutrient	Low	Medium	High
N, P and K	< 1.67	1.67 – 2.33	> 2.33

In continuation of the above context, the present study was undertaken to comprehensively evaluate the soil fertility status of Amalipadar village in Gariaband district, Chhattisgarh, with a focus on both macro- and micronutrient availability. The investigation aims to assess the spatial variability of key soil physico-chemical properties, including soil pH, electrical conductivity (EC), organic carbon (OC), and available nutrients such as nitrogen (N), phosphorus (P), potassium (K), sulphur (S), and micronutrients like boron (B), zinc (Zn), copper (Cu), iron (Fe), and manganese (Mn). Based on the analytical results, a fertility index will be developed to categorize the nutrient status of the study area, thereby providing a scientific basis for soil fertility evaluation. Furthermore,

Supplementary Table 1: Ratings of Soil Test Values.

1. Soil pH Values				
Strongly acidic	**MA**	**SA**	**N**	**SAk**
< 4.5	4.5-5.5	5.5-6.5	6.5-7.5	7.5-8.5
2. Classification for Total Soluble Salt Content (EC as dS m^{-1})				
Good	**Fair**	**Poor**	**Toxic**	
< 1.0	1.0 – 2.0	2.0 – 3.0	> 3.0	
3. Organic Carbon Content (g kg^{-1})				
Soil parameter	**Low**	**Medium**	**High**	
Organic C (g kg^{-1})	< 5	5 – 7.5	> 7.5	
4. Classification for Available Macronutrients Status				
Soil parameter	**Low**	**Medium**	**High**	
Available N (kg ha^{-1})	< 280	280 – 560	> 560	
Available P (kg ha^{-1})	< 12.5	12.5 – 25	> 25	
Available K (kg ha^{-1})	< 135	135 – 335	> 335	
Available S (kg ha^{-1})	< 22.5	22.5 – 45	> 45	
5. Classification for Available Micronutrients Status				
Soil parameter	**Low**	**Medium**	**High**	
Available Fe (mg kg^{-1})	< 4.5	4.5 – 9.0	> 9.0	
Available Mn (mg kg^{-1})	< 3.5	3.5 – 7.0	> 7.0	
Available Cu (mg kg^{-1})	< 0.2	0.2 – 0.4	> 0.4	
Available Zn (mg kg^{-1})	< 0.6	0.6 – 1.2	> 1.2	
Available B (mg kg^{-1})	< 0.5	0.5 – 1.0	> 1.0	
MA: Moderately acidic; SA: Slightly acidic; N: Neutral; SAk: Slightly alkaline				

Table 2: Soil fertility rating for sulphur and micronutrients based on NIV.

Nutrient	Very Low	Low	Marginal	Adequate	High	Very High
S and micronutrients (Fe, Mn, Cu, Zn)	<1.33	1.33-1.66	1.66-2.00	2.00-2.33	2.33-2.66	>2.66

the study seeks to generate soil test-based fertilizer recommendations tailored to major crops grown in the region, ensuring efficient nutrient management, improved crop productivity, and sustainable soil health in line with guidelines advocated by the Indian Council of Agricultural Research.

Material and Methods

Study area

Amalipadar village of Gariaband district C.G. is located at the 19.92° N latitude to 82.43° E longitude. Amalipadar has a total population of 3,748 0 peoples. The total geographical area of the village is 707 ha. Rice, Wheat, Maize, Jowar, Lathyrus are the major crops in the area, other important crops are minor viz. pigeon pea, chickpea and field pea. The district experiences a tropical climate, with the majority of rainfall brought by monsoon winds originating from the Bay of Bengal. The monsoon season in the district typically spans from mid-June to the end of September, with the heaviest rainfall occurring in July and August. The state receives rain primarily from the south-western monsoon winds coming from the Bay of Bengal.

Sample collection and analysis

From the selected area surface soil sample (0-15 cm) were collected via a random sampling method, using khasra number. Quartering it, following the standard sampling procedures for sampling. The soil is then air dried, removing stone, pebbles or roots if present any then grinding it using wooden block. The dried samples are then passed through 2mm sieve and stored in a tight clothing /polythene bag. The soil of the study area is Entisols, Inceptisols, Alfisols and Vertisols order. The sample was analysed for 12 parameters pH, electrical conductivity, organic carbon, available nitrogen, phosphorous, potassium, sulphur and DTPA extractable Fe, Mn, Cu, Zn and hot water extractable B from the soil. The pH and EC were determined through the soil-water extract (1:2.5; soil: water) through potentiometry and conductimetry method (Piper, 1967), organic carbon through Walkley and Black (1934). Available N through alkaline permanganate method (Subbiah and Asija 1956), available P through 0.5M $NaHCO_3$ with pH- 8.5 (Olsen *et al.*, 1654), available K through neutral normal ammonium acetate method (Hanway and Heidal,1952), and available S through $CaCl_2$ extractable method (Williams and Steinbergs, 1969). Whereas available micronutrients following a DTPA extraction method (Lindsay and Norvell, 1978).

Methodology for Nutrient Index Value

Nutrient index value (NIV) for the various soil parameters was calculated from the number or proportion of samples under low, medium and high available nutrient status and were then categorised in distinct fertility classes as per the methods (Ramamoorthy and Bajaj, 1969).

Nutrient index = [per-cent in low category × 1+ per-cent in medium category × 2 + per -cent in high category ×3] /100

In this assessment, a nutrient index was categorised as per Ghosh and Hasan, 1976 presented in Table 1 and 2.

Rating of the soil test values

The rating of the individual soil test values in to the

Supplementary Table 2: Correlation between various soil parameters

Parameter	pH	EC	OC	N	P	K	B	S	Fe	Mn	Cu	Zn
pH	1											
EC	0.16	1										
OC	-0.1	0.13	1									
N	-0.05	0.08	0.68**	1								
P	0.22**	-0.05	-0.09	-0.09	1							
K	-0.15	0.15*	0.19*	0.13	-0.1	1						
B	0	0.01	0.11	-0.02	0	0.04	1					
S	0.11	-0.09	-0.06	0.01	0.04	-0.08	-0.02	1				
Fe	-0.03	-0.14	-0.05	-0.01	0.1	0.06	0.15	0.03	1			
Mn	-0.14	-0.07	0.05	0.01	0.05	0.08	0.11	-0.07	0.76**	1		
Cu	-0.05	-0.11	0.09	-0.03	0.03	0.16*	0.11	0.03	0.30**	0.34**	1	
Zn	-0.02	-0.03	-0.04	0.03	-0.03	-0.14	0.04	-0.03	0.13	0.12	-0.17	1

* and ** indicate significance at P = 0.05 and 0.01, respectively

Table 3: Distribution of soil under different pH rating.

Classes	Range	No. of samples	Per cent of samples
Slightly acidic (5.5–6.5)	6.01 – 6.55	110	69
Neutral (6.5–7.5)	6.56 – 7.52	44	27
Slightly alkaline (7.5–8.5)	7.64 – 7.91	6	4

three classes was performed according to the following limits. Ramamoorthy and Bajaj, 1969 have been adopted by most of the soil testing laboratories in the country.

Result and Discussion

Soil pH

A study on the collected samples of the area indicated that the soil pH of varied from 6.01 to 7.91 with an average value of 6.60. Results revealed that soil pH varies from slightly acidic to slightly alkaline in range. Among 160 soil samples, it was found that 69 per-cent samples were categorised under slightly acidic soil reaction followed by 27 per-cent of samples in neutral and rest 4 per-cent of samples fall under the alkaline category (Table 3). The result obtained is also in line with the previous finding Balkrishna *et al.*, (2017) in the soil of Palari Block under Baloda bazar district and result of Singh *et al.*, (2017) in soil Baloda bazar district of Chhattisgarh.

Electrical conductivity

EC in the study area ranged from 0.05 to 0.23 dSm^{-1}, with mean of 0.14 dSm^{-1}, indicating that the soil in the study area had a very low number of soluble salts within a narrow EC range. It was discovered that the whole 160 soil samples were classified within a good EC range (Table 4). Our results are in close agreement with findings of Kunal *et al.*, (2013) in soils of Akaltara block of Janjgir district of Chhattisgarh.

Organic Carbon

The soil organic carbon content ranged from 2.17 g kg^{-1} to 7.59 g kg^{-1}, with an average value of 5.84 g kg^{-1}. Based on the organic carbon content, the samples were classified under different classes. Of the 160 samples, 28 per-cent was rated as low, 71 per-cent as medium, and 1 per-cent high in organic carbon category. The soil carbon content ranged from low to medium in this area can be attributed to climatic factors. The prevailing tropical climate results in high temperatures, which promote soil organic carbon oxidation through microbial activity.

Table 4: Distribution of soil samples under different EC rating.

Soil EC Classes	Range ($dS\ m^{-1}$)	No. of samples	Per cent of samples
Good (No harmful effect on crop)	< 1	160	100

Table 5: Distribution of soil samples under different organic carbon rating.

Classes	Range ($g\ kg^{-1}$)	No. of samples	Per cent of samples
Low (<5)	2.17 – 4.96	43	28
Medium (5–7.5)	5.1 – 7.44	116	71
High (>7.5)	7.59	1	1

Additionally, the field remained barren in the previous year without any manuring, contributing to the low to medium soil carbon status. These results also match with the finding of Jatav *et al.*, (2010) in soil of Baloda block in Chhattisgarh (Table 5).

Available Nitrogen

The available nitrogen status in the study area ranged from 125.44 to 275.9 kg ha^{-1}, with an average value of 206.87 kg ha^{-1} (Table 6). It was discovered that 100 percent of the study area had low available nitrogen. However, the soil available nitrogen recovery efficiency of the alkaline $KMnO_4$ method by Subbiah and Asija (1956) is only 70-76 per-cent, meaning it recovers only the oxidizable nitrogen fraction of the dry soil nitrogen pool. The apparent nitrogen deficiency across the entire area can be due to poor organic carbon content in the soil, which is the primary source of nitrogen. Additionally, downward movement of nutrient and washout of nitrogen forms could contribute to the low nitrogen levels in the study area's soil.

The result obtained for available N is also in line with the finding of Singh *et al.*, (2016) in soils of Milkipur village, Varanasi district where 100 per-cent collected samples were found deficient in available Nitrogen.

Available P

The available phosphorus status in the study area, classified according to standard values in Table 4 ranged from 4.25 to 37.95 kg ha^{-1}, with a mean of 16.61 kg ha^{-1} (Table 7). It was revealed that 27 per-cent of the samples fell under the deficient category, 66 per-cent was in the medium range, and 7 per-cent in the higher range of available phosphorus content. The same results were also reported by Kumar *et al.*, (2014) villages in Kabeer Dham district were 297 samples identified from Vertisol's study indicates that about 87 per-cent of the sampled area exhibited low and 13 per-cent under medium range of P content.

Table 6: Distribution of soil samples under different Nitrogen rating.

Soil available N (kg ha^{-1})			
Class	Range	No. of samples	Percent of samples low
Low (<280)	125.44 - 275.9	160	100

Table 7: Distribution of soil samples under different Phosphorus rating.

Soil available P (kg ha^{-1})			
Classes	**Range (g kg^{-1})**	**No. of samples**	**Per cent of samples**
Low (<12.5)	4.25-12.43	44	27
Medium (12.5–25)	12.86-24.91	105	66
High (>725)	25.36-37.95	11	7

Available K

The soil samples from the study area were found to have medium to high available potassium status. The available potassium content varied between 112.23 and 553.10 kg ha^{-1} with an average value of 284.95 kg ha^{-1} (Table 8). Based on standard rating values for soil potassium status, 11 samples were classified as low in potassium, 62 per-cent as medium, and 31per-cent as high in potassium content. The medium to high potassium status of the soil can be attributed to the presence of expanding clay minerals, such as Montmorillonite, in the study area. These minerals tend to adsorb potassium onto surface negative sites and trap potassium within the clay lattice, releasing it as the external potassium reserves are depleted, thereby maintaining a healthy potassium pool for plant requirements. The result was also in line with the findings of Jatav *et al.*, (2010) in soils of *Inceptisols* of Baloda bazar block of Janjgir district, the study area data reveals that 95.61 per-cent soil samples tested were in medium level of available K and also in Meher *et al.*, (2019) in soils of KVK farm of Pahanda, Durg. Among all the collected soil samples 36.54 per-cent samples were in medium and rest 63.46 per-cent samples were in high fertility categories, the result ascribes no available K deficient in the study area.

Available S

The available sulphur content in the area was determined and categorised into various standard rating values (Table 9). The sulphur content ranged from 1.26 to 35.53 kg ha^{-1}, with an average value of 24.83 kg ha^{-1}. Out of the 160 samples analysed, 33 per-cent was found low in sulphur, 67 per-cent in medium. The Nutrient Index value for sulphur fertility was 1.68, which falls under the medium range (medium 1.67-2.33). The majority of the area had a sulphur status within the low to medium range, which may be due to the poor organic carbon reserves and the leaching and runoff losses of sulphate ions, given their anionic nature, from the surface layer of the study area. These finding are also in line with the report of Meher *et al.*, (2019). They estimated S status of KVK of Pahanda, Durg collecting 52 samples from the KVK farm and reported that the S content of various areas ranging between 11.20 to 39.60 kgha^{-1}with a mean content of 27.27 kg ha^{-1}.

Table 8: Distribution of soil samples under different Phosphorus rating.

Soil available K (kg ha^{-1})			
Classes	**Range (g kg^{-1})**	**No. of samples**	**Per cent of samples**
Low (<135)	112.23-134.96	11	7
Medium (135–335)	135.67-334.09	100	62
High (>335)	339.24-553.10	49	31

Table 9: Distribution of soil samples under different Sulphur rating.

Soil available S (kg ha^{-1})			
Classes	**Range (g kg^{-1})**	**No. of samples**	**Per cent of samples**
Low (<22.5)	1.26-21.86	52	32
Medium (22.5-45)	22.76-35.53	108	68

Available Micronutrient Status

The available micronutrient in soil sample was presented in Table 10. The iron status varied from 6.26 to 37.67 mg kg^{-1}, with a mean value of 14.71 mg kg^{-1}. Out of 160 samples analysed 14 per-cent samples was found to be sufficient and 86 per-cent was high in category. The result obtained is also supported by the previous finding of Mandal *et al.*, (2018) in the soil of

Table 10: Distribution of soil samples under different micronutrient rating.

Soil available Fe (mg kg^{-1})			
Classes	**Range (mg kg^{-1})**	**No. of samples**	**Per cent of samples**
Sufficient (>4.5)	6.26 – 8.96	22	14
High (>9.0)	9.05 – 37.67	138	86
Soil available Mn (mg kg^{-1})			
Classes	**Range (mg kg^{-1})**	**No. of samples**	**Per cent of samples**
Sufficient (3.5–7.0)	3.57–6.99	94	59
High (>7.0)	7.02–21.45	66	41
Soil available Cu (mg kg^{-1})			
Classes	**Range (mg kg^{-1})**	**No. of samples**	**Per cent of samples**
Sufficient (0.2–0.4)	1.00–2.90	160	100
Soil available Zn (mg kg^{-1})			
Classes	**Range (mg kg^{-1})**	**No. of samples**	**Per cent of samples**
Deficient (<0.6)	0.25–0.41	160	100
Soil available B (mg kg^{-1})			
Classes	**Range (mg kg^{-1})**	**No. of samples**	**Per cent of samples**
Deficient (<0.5)	0.17–0.48	116	72

Table 11: Overall fertility classes based on the NIV.

S. No.	Soil characteristics	Range	Average	Per-cent samples category			NIV	Fertility class
				Low	Medium	High		
1	N (kg ha^{-1})	125.44 – 275.96	209.87	100	0	0	1	Low
2	P (kg ha^{-1})	4.25 – 37.95	16.61	27	66	7	1.84	Medium
3	K (kg ha^{-1})	112.33 – 553.10	284.95	7	62	31	2.24	Medium
4	S (kg ha^{-1})	1.26-35.53	24.83	32	68	0	1.68	Medium
5	Fe (mg kg^{-1})	6.26-37.67	14.71	0	14	86	2.86	High
6	Mn (mg kg^{-1})	3.57-21.45	14.71	0	59	41	2.41	High
7	Cu (mg kg^{-1})	1.00-2.90	1.54	0	100	0	2	Medium
8	Zn (mg kg^{-1})	0.24-0.41	0.27	100	-	0	1	Low
9	B (mg kg^{-1})	0.1-5.79	0.57	72	17	11	1.9	Medium

Chhattisgarh plains and result of Singh *et al.,* (2017) in soil of Balodabazar district of Chhattisgarh.

Available Manganese ranged from 3.57-21.45 mg kg^{-1} with a mean of 14.71 mg kg^{-1} where 59 per-cent was found to be sufficient, and 41 per-cent was rated as high in Mn content. These results were also supported by the previous findings of Singh (2017) in soils of Calabaza block under Balodabazar district of Chhattisgarh and Mandal *et al.,* (2018) in the soil of Chhattisgarh plains where the iron content found to be varied from 2.30 to 40.98 mg kg^{-1}.

Available copper (Cu) content ranged from 1.00 to 2.90 mg kg^{-1}, with an average content of 1.54 mg kg^{-1}. All of the samples was classified in the high rating category for copper content. These results also come in line with the findings of Motghare (2019) in soil of Arang block under Raipur district of Chhattisgarh which ranges from 7.16 to 35.56 mg kg^{-1} (Avg. = 19.37 mg kg^{-1}), also supported by Radhika *et al.,* (2012) which also confirm the same in soil of Nagri block in Chhattisgarh when they found 88 percent of collected samples in high Cu content range.

The soil available zinc (Zn) status in the study area was found to range between 0.25 and 0.41 mg kg^{-1} with an average value of 0.27 mg kg^{-1}. Upon classification into different rating categories, it was found that 100 per-cent of the samples was deficient in available zinc. The result obtained for available Zn is also in line with the finding of Mandal *et al.,* (2018) in soil of Chhattisgarh plain area. The finding of Khadka *et al.,* (2017) in soils of NRRP, Dhanusha, Nepal in overall, available zinc was low in status. There may have possibility of zinc deficiency disorder in rice known as Khaira at young age usually in nursery. Therefore, regularly zinc rich organic and inorganic sources of materials should be incorporated for adequate supply of zinc for rice.

Whereas boron status ranged from deficient to sufficient in available boron status. The available boron content of the soil varied from 0.17 to 5.79 mg kg^{-1}, with a mean content of 0.57 mg kg^{-1}. These results were in line with the finding of Motghare *et al.,* (2019) as they reported that available B status is found to be varied from 0.10 to 0.99 mg kg^{-1} with a mean B content of 0.34± 0.15 mg kg^{-1}. These results are also in conformity with Kumar *et al., (*2011) as they reported available B status is found to be varied from 0.37 to 1.51 mg kg^{-1}.

Nutrient Index Value (NIV)

The soil samples were rated low for available nitrogen, The Nutrient Index (NI) value of the area for phosphorus fertility was found to be 1.84, placing it in the medium NI range (Medium 1.67-2.33). The Nutrient Index value for potassium fertility in the soil was found to be 2.24, which falls under the medium rating (medium 1.67-2.33). The Nutrient Index value for sulphur fertility was 1.68, which falls under the medium range (medium 1.67-2.33). As for micronutrient, the soil nutrient index value (NIV) for the iron and manganese was high in soil fertility rating with 2.86 and 2.41 indicating no significant crop production constraints in the soil. Copper and boron with medium fertility category whereas zinc falls under low fertility category as displayed in Table 11.

Correlation between various soil parameters

The correlation study had been performed among all the soil chemical parameters to find out their relationship in respect to their availability given in Supplementary Table 2. The soil pH was positively correlated with available P (r2 = 0.2159**) indicating that the availability of P in soil is depend on soil pH up to a certain value. With increasing the soil pH up to neutral value, the soil P availability will also increase. Similarly, organic C was found positively correlated with available N (0.68**) and with available K (0.18791*). Indicating the greater dependence of available N on soil organic carbon followed by available K. Among the micronutrient soil Fe was positively correlated with the Mn (0.75455**) and Cu (0.26542**). Indicating that soil Mn and Cu content will greatly influence with the levels of Fe in the soil. Whereas Mn was found to be positively correlated with Cu (0.30**), revealed that availability of Cu in soil dependent on the availability of Mn in soil up to a certain level. Rakshit *et al., (*2018) carried out an experiment to assess the soil quality at College of Agriculture and Research Farm, Bhagalpur, Bihar and using principal component method estimated the inter-correlation between soil organic carbon and other soil parameters. They found that soil organic C had a significantly positive correlation with soil N (r = 0.986**), P (r = 0.918**). Devdas (2016) evaluated soil fertility status of Gariaband area and found that Mn content in the soil showed a significantly negative correlation with soil pH (r = -0.203**) but significantly positive correlation with Fe (r =0.404**) status of area.

Conclusion

The major area of Amalipadar village was slightly acidic to neutral and slightly alkaline in pH, safe in electrical conductivity, low to medium in organic carbon content. The overall rating of nutrients based on NIV value were low in available nitrogen, medium in available phosphorus and available potassium was recorded. Regarding available sulfur and micronutrients, Sulphur, and boron was medium and, while Fe, Mn under high, Cu in medium category and zinc comes under low category. As a whole available nitrogen, boron, and zinc are the major nutrients constraints for sustaining the soil fertility and crop productivity in Amalipadar village. In future, soil sampling should be conducted at different depths based on the crops grown in the study area to accurately assess the nutrient status according to crop requirements. Additionally, the study carried out in Amalipadar village should be extended to other villages, blocks, and districts of Chhattisgarh to promote environmentally sustainable agricultural practices through balanced fertilizer application based on comprehensive soil fertility assessments.

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