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# Soil fertility assessment and mapping of chungbang farm, Pakhribas, Dhankuta, Nepal

## Abstract

Soil fertility evaluation is a basic factor for sustainable planning of a particular area. Thus, a study was done to assess the soil fertility status of the Chungbang farm, Pakhribas, Dhankuta, Nepal. The farm is situated at the latitude 27.00739°N and longitude 87.25894°E as well altitude 1176masl. The total 27 soil samples were collected randomly at a depth of 0-20 cm by using soil sampling auger. A GPS device was used for determination of geographical position of soil sampling points. The collected samples were analyzed for their texture, pH, OM, N, $P_2O_5$, $K_2O$, Ca, Mg, S, B, Fe, Zn, Cu and Mn status following standard analytical methods in the laboratory of Soil Science Division, Khumaltar. The Arc-GIS 10.1 software was used for the preparation of soil fertility maps. The observed data revealed that structure was granular and sub-angular blocky, whereas colour were yellowish brown and brown. The sand, silt and clay content were 59.25±1.01%, 27.41±0.83% and 13.34±0.38%, respectively and categorized as sandy loam in texture. The soil was very acidic in pH (4.75±0.07) and very low in available boron (0.21±0.05mg/kg), available sulphur (1.22±0.34mg/kg) and available zinc (0.20±0.02mg/kg). The organic matter (1.32±0.13%), total nitrogen (0.08±0.004%) and available calcium (512.5±36.3mg/kg) were low in status. Similarly, available potassium (104.1±12mg/kg) and available magnesium (66.27±7.33mg/kg) were medium in status. Consequently, the available iron (20.59±2.91mg/kg) was high, while available phosphorus (54.88±7.19mg/kg), available copper (2.96±0.62mg/kg) and available manganese (31.19±2.94mg/kg) were very high in status. The determined soil test data can be used for sustainable soil management as well as developing future research strategy in the farm.

**Keywords:** nutrient management, research strategy, soil analysis, soil fertility maps, sustainable planning

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Dinesh Khadka,[1] Sushil Lamichhane,[1] Parashuram Bhantana,[2] Anisur R Ansari,[2] Sushila Joshi,[1] Phatta Baruwal[2]

[1]Soil Science Division, NARC, Khumaltar, Lalitpur, Nepal

[2]Agricultural Research Station, NARC, Pakhribas, Dhankuta, Nepal

**Correspondence:** Dinesh Khadka, Soil Science Division, NARC, Khumaltar, Lalitpur, Nepal, Email dinesh.khadka92@gmail.com

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**Abbreviations:** NARC, Nepal Agricultural Research Council; GPS, Global Positioning Systems; GIS, Geographical Information System

## Introduction

Soil is most vital resource for the sustained quality of human life and the foundation of agricultural development.[1] The development and survival of civilizations has been based on the performance of soils on this land to provide food and further essential goods for humans (Hillel, 2009). Efficient management of soil resource is a major challenge for the scientists, planners, administrators and farmers to ensure food security for the present and future generation.[2] Soil fertility is the inherent capacity of soil that enables it to provide essential plant elements in quantities and proportions for the growth of specified plant when other factors are favorable.[3] It indicates plant growth in relation to nutrient available in soil. Soil test-based fertility management is an effective tool for increasing productivity of agricultural soils that have high degree of spatial variability resulting from the combined effects of physical, chemical or biological processe.[4] Soil testing provides information regarding nutrient availability in soils which forms the basis for the fertilizer recommendations for maximizing crop yields. The texture, structure, colour etc. are important soil physical parameters. Similarly, soil reaction (pH), organic matter, macro and micronutrients etc. are also important soil chemical parameters. These parameters determined after analyzing efficiently in the laboratory. Soil properties vary spatially from a field to a larger regional scale and it is affected by soil forming factors which can be termed as intensive factors and extrinsic factors such as soil management practices, fertility status, crop rotation etc.[5] Describing the spatial variability of soil fertility across a field has been difficult until new technologies such as Global Positioning Systems (GPS) and Geographic Information Systems (GIS) were introduced. Collection of soil samples by using GPS is very important for preparing thematic soil fertility maps.[6] Similarly, Geographical Information System (GIS) is a potential tool used for easy access, retrieval and manipulation of voluminous data of natural resources often difficult to handle manually. It facilitates manipulation of spatial and attributes data useful for handling multiple data of diverse origin.[7] Nepal Agricultural Research Council (NARC) was established to strengthen agriculture sector in the country through agriculture research. Chungbang farm (a research site of Agricultural Research Station, Pakhribas, Dhankuta) is an important wing among the research farms of NARC, in order to generate appropriate agriculture production technologies for eastern hills of Nepal. This farm is used for various kinds of research in the field crops, vegetables and fruits, from longer period of time. Whereas, low soil fertility is a major constraints in the different research domains of NARC.[8–13] This causes problem for adequate technology generation from the day to day research. Similarly, studies related to the soil fertility status of Chungbang farm are not done yet. Therefore, it is important to investigate the soil fertility status and may provide valuable information relating sustainable soil management, as well improving quality of field research. Keeping these facts, the present study was conducted with the objective to assess the soil fertility status of Chungbang farm, Pakhribas, Dhankuta, Nepal.

## Materials and methods

### Study area

The study was carried out at Chungbang farm, Pakhribas, Dhankuta, Nepal (Figure 1). The research farm is situated at the latitude 27.00739°N and longitude 87.25894°E as well altitude 1176masl. This farm is a research site of Agriculture Research Station, Pakhribas, Dhankuta, Nepal.

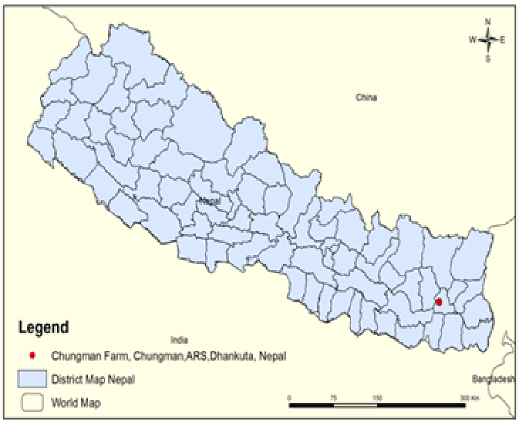


**Figure 1** Location Map of Chungbang Farm, Pakhribas, Dhankuta, Nepal.

### Soil sampling

Surface soil samples (0-20 cm depth) were collected from different sites of Chungbang farm during April 2016. The total 27 soil samples were collected from the research farm by using soil sampling auger (Figure 2). The exact locations of the samples were recorded using a handheld GPS receiver. The random method based on the variability of the land was used to collect soil samples.

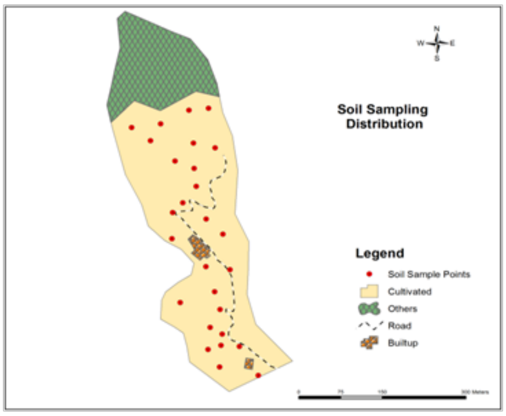


**Figure 2** Distribution of Soil Sample Points during Soil Sampling.

### Laboratory analysis

The collected soil samples were analyzed at laboratory of Soil Science Division, Khumaltar. The different soil parameters tested as well as methods adopted to analyze is shown on the Table 1.

### Statistical analysis

Descriptive statistics (mean, range, standard deviation, standard error, coefficient of variation) of soil parameters were computed using the Minitab 17 package. Rating (very low, low, medium, high and very high) of determined values were based on Soil Science Division, Khumaltar. The coefficient of variation was also ranked for determination of nutrient variability according to the procedure of[23] where, CV≤25%=low variation, CV>25≤ 50%=moderate variation, CV>50%= high variation. Arc Map 10.1 with geostatistical analyst extension of Arc GIS software was used to prepare soil fertility maps, while interpolation method employed was ordinary kriging with stable semi-variogram. Similarly, the nutrient index was also determined by the formula given by.[24]

$$\text{Nutrient index (N.I.)} = (N_L \times 1 + N_M \times 2 + N_H \times 3)/N_T$$

Where, $N_L$, $N_M$ and $N_H$ are number of samples falling in low, medium and high classes of nutrient status, respectively and $N_T$ is total number of samples analyzed for a given area. Similarly, interpretation was done as value given by Ramamoorthy shown on the Table 2.

**Table 1** Parameters and Methods Adopted for the Laboratory Analysis at Soil Science Division, Khumaltar

| S.N. | Parameters | Unit | Methods |
|---|---|---|---|
| 1 | Physical | | |
| | Soil texture | | Hydrometer[14] |
| | Soil colour | | Munshell-colour chart |
| | Soil structure | | Field-feel |
| 2 | Chemical | | |
| | Soil pH | | Potentiometric 1:2[15] |
| | Organic matter | % | Walkely and Black[16] |
| | Total N | % | Kjeldahl[17] |
| | Available $P_2O_5$ | mg/kg | Olsen's[18] |
| | Available $K_2O$ | mg/kg | Ammonium acetate (Jackson, 1967) |
| | Available Ca | mg/kg | EDTA Titration[19] |
| | Available Mg | mg/kg | EDTA Titration[19] |
| | Available S | mg/kg | Turbidimetric[20] |
| | Available B | mg/kg | Hot water[21] |
| | Available Fe | mg/kg | DTPA[22] |
| | Available Zn | mg/kg | DTPA[22] |
| | Available Cu | mg/kg | DTPA[22] |
| | Available Mn | mg/kg | DTPA[22] |

**Table 2** Rating Chart of Nutrient index

| S.N. | Nutrient Index | Value |
|---|---|---|
| 1 | Low | <1.67 |
| 2 | Medium | 1.67-2.33 |
| 3 | High | >2.33 |

## Results and discussion

The soil fertility status of the study area was assessed with respect to texture, colour, structure, pH, organic matter, primary nutrients, secondary nutrients and micronutrients such as B, Fe, Zn, Cu, and Mn, and the results obtained are presented and discussed in the following headings.

## Soil texture

Texture has been considered as an indicator in several studies[25,26] and is an important soil physical property for characterizing soils. It affects the infiltration and retention of water, soil aeration, absorption of nutrients, microbial activities, tillage and irrigation practices.[27] The sand, silt and clay are the three components of soil texture. The sand of soil samples ranged from 51 to 69% with a mean of 59.25% and that of % silt were 20.2 to 36.2% with a mean of 27.41%, while the range of % clay were 8.8 to 17% with a mean of 13.34% (Table 3) (Figure 3). The coefficients of variation between the soil samples were low for sand (8.83%) and silt (15.67%) and clay (14.93%). The determined soil texture is satisfactory for most of the agricultural purpose.

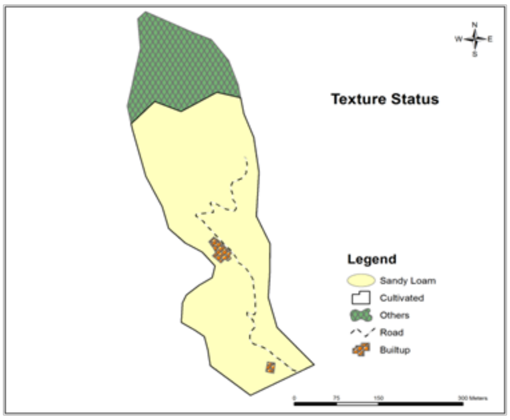


**Figure 3** Soil Texture Status of Chungbang Farm, Pakhribas, Dhankuta, Nepal.

**Table 3** Soil Texture Status of Chungbang Farm, Pakhribas, Dhankuta, Nepal

| **Soil separates** | | | |
|---|---|---|---|
| **Descriptive Statistics** | **Sand** | **Silt** | **Clay** |
| | % | | |
| Mean | 59.25 | 27.41 | 13.34 |
| SEM | 1.01 | 0.83 | 0.38 |
| SD | 5.23 | 4.29 | 1.99 |
| Minimum | 51 | 20.2 | 8.8 |
| Maximum | 69 | 36.2 | 17 |
| CV% | 8.83 | 15.67 | 14.93 |
| Class | Sandy Loam | | |

## Soil colour

Soil colour is an indirect measure of other important characteristics such as water drainage, aeration, and organic matter content of soils.[28] Two soil colour yellowish brown (10YR 5/4), and brown (10YR 4/3) was observed in the majority of the area.

## Soil structure

Soil structure refers to the pattern of spatial arrangement of soil particles in a soil mass.[29] It is a complex category and a key to soil biological, chemical and physical processes.[30,31] Poor structure can result in lower crop yields and greater leaching losses.[32] The granular and sub-angular blocky types of soil structure were observed in the majority of the study area. The observed soil structure is favorable for agricultural purpose.

## Soil pH

Soil pH is considered a master variable in soils as it affects many chemical processes.[33] High acidity is a major constraint in the different research farms of NARC.[9,11] The pH of soil varied from 3.99 to 5.43 with a mean value of 4.75 (Table 4). This indicates very acidic soil pH (Figure 4). The soil pH showed low variability (8.05%) among the soil samples. The occurrence of acidic parent materials like quartz, granite, rhyolite etc. might be the cause of high acidity.[3] The normal pH range for optimal mineral elements availability for most crops is 6.0 to 7.5.[34] High acidity causes loss of basic cations such as Ca and Mg, increases phototoxic elements such as Al and Mn; reduces beneficial microbial population, deteriorates soil structure, hence makes soil unhealthy.[35] There is need to reduce soil acidity in order to improve soil fertility for sustainable soil fertility management. Therefore, periodically agricultural lime (128 kg/kattha) should be applied to make soil pH adequate.

**Table 4** Soil Fertility Status of Chungbang Farm, Pakhribas, Dhankuta, Nepal

| **Soil Fertility Parameters** | | | | | |
|---|---|---|---|---|---|
| **Descriptive Statistics** | **pH** | **OM** | **N** | **P2O5** | **K2O** |
| | | % | | mg/kg | |
| Mean | 4.75 | 1.32 | 0.08 | 54.88 | 104.1 |
| SEM | 0.07 | 0.13 | 0.004 | 7.19 | 12 |
| SD | 0.38 | 0.65 | 0.02 | 37.36 | 62.3 |
| Minimum | 3.99 | 0.07 | 0.04 | 10.71 | 2.6 |
| Maximum | 5.43 | 2.55 | 0.11 | 157.85 | 258.9 |
| CV% | 8.05 | 49.33 | 24.45 | 68.08 | 59.82 |

SEM, Standard error of the mean; SD, Standard deviation

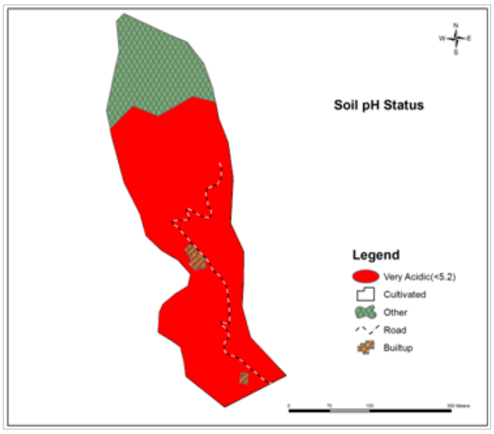


**Figure 4** Soil pH Status of Chungbang Farm, Pakhribas, Dhankuta, Nepal.

## Organic matter

Soil organic matter is any material of biological origin that decomposes and becomes part of the soil.[36] The organic matter content varied from 0.07 to 2.55% with a mean value of 1.32% (Table 4). This shows low organic matter status (Figure 5), (Table 7). The low soil organic matter is a major challenge for sustainable soil management in the different research domains of NARC.[10,12,13] The adopted different improper agriculture practices like nutrient management, crop rotation, tillage etc. might be the cause of low content of organic matter.[29] Therefore, incorporation of different organic matter adding materials, adoption of suitable crop rotation, crop residue management, mulching and tillage is important for soil organic matter improvement. Organic matter showed moderate variability (49.33%) among the soil samples.

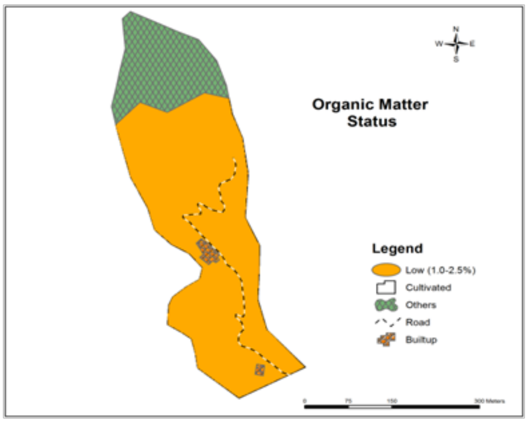


**Figure 5** Organic Matter Status of Chungbang Farm, Pakhribas, Dhankuta, Nepal.

## Total nitrogen

Nitrogen is most important element required for plants in the greatest amount, which comprises about 1.5–2.0% of plant dry matter, besides approximately 16 % of total plant protein.[37,38] The total nitrogen content ranged from 0.04 to 0.11% with a mean of 0.08% (Table 4). This indicates low content of total nitrogen (Figure 6); (Table 7). The low content of total nitrogen might be due to low content of organic matter (Figure 5) as well high leaching loss of inorganic nitrogen from the soil. Because nitrogen is a major component of organic matter.[29] The low content of nitrogen signifies, full dose (100%) of the recommended nitrogen is requires for adequate supply of nitrogen for crops in the farm.[39] Low variability (24.45%) in total nitrogen was observed among the sampled soils.

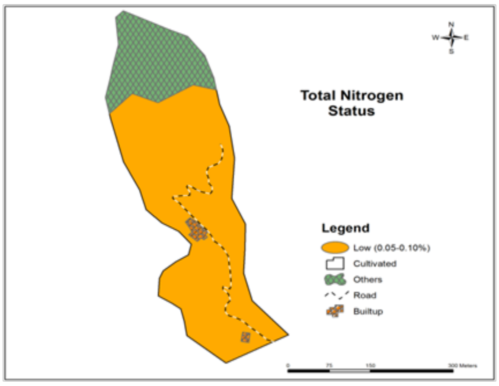


**Figure 6** Total Nitrogen Status of Chungbang Farm, Pakhribas, Dhankuta, Nepal.

## Available phosphorus

Phosphorus has been called the "Master key to agriculture" because low crop production is attributed mainly to the deficiency of phosphorus, except nitrogen, than the deficiency of other elements.[40] The available phosphorus ($P_2O_5$) ranged from 10.71 to 157.85 mg/kg with a mean value of 54.88 mg/kg (Table 4). This showed very high status of available phosphorus (Figure 7, Table 7). Phosphorus is very immobile element in the soil.[33] The continuous application of phosphate fertilizer without knowing availability in the soil might be the cause of high phosphorus level in the very acidic as well as low organic matter containing soil (Figure 4, Figure 5). The phosphorus content is adequate; therefore 40% of the recommended phosphorus dose might be sufficient in the farm.[39] Available phosphorus showed high variability (68.08%) among the tested soil samples.

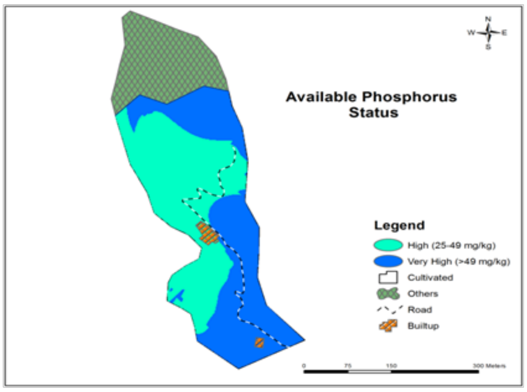


**Figure 7** Available Phosphorus Status of Chungbang Farm, Pakhribas, Dhankuta, Nepal.

## Available potassium

Potassium is an essential macronutrient for plants involved in many physiological processes.[41] The available potassium ($K_2O$) content ranged from 2.60 to 258.90 mg/kg with a mean value of 104.10 mg/kg. This suggests medium status of available potassium (Figure 8), (Table 7). The area having medium and high status, 60% and 40%, respectively of recommended potassium dose should be sufficient in the farm.[39] High variability (59.82%) in available potassium was determined among the soil samples.

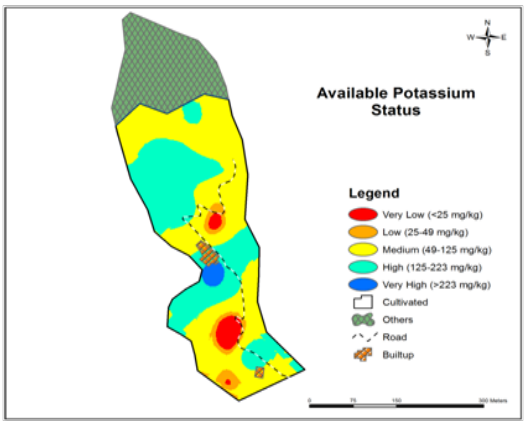


**Figure 8** Available Potassium Status of Chungbang Farm, Pakhribas, Dhankuta, Nepal.

**Citation:** Khadka D, Lamichhane S, Bhantana PR, et al. Soil fertility assessment and mapping of chungbang farm, Pakhribas, Dhankuta, Nepal. *Adv Plants Agric Res.* 2018;8(3):219–227. DOI: 10.15406/apar.2018.08.00317

## Available calcium

Calcium is important secondary nutrients required for cell growth, division, elongation, and various essential biological functions.[42] The calcium content ranged from 220 to 858 mg/kg with a mean value of 512.50 mg/kg (Table 5). This indicates low status of available calcium (Figure 9, Table 7). The very high soil acidity might be the cause of low calcium status. The availability of basic cations reduced at low pH.[33] Therefore, amelioration of soil acidity is a prerequisite solution for increasing calcium availability in the farm. Moderate variability (36.77%) in available calcium was observed among the soil samples.

**Table 5** Soil Fertility Status of Chungbang Farm, Pakhribas, Dhankuta, Nepal

| Soil Fertility Parameters | | | | |
|---|---|---|---|---|
| Descriptive Statistics | Ca | Mg | S | B |
| | mg/kg | | | |
| Mean | 512.5 | 66.27 | 1.22 | 0.21 |
| SEM | 36.3 | 7.33 | 0.34 | 0.05 |
| SD | 188.4 | 38.11 | 1.74 | 0.25 |
| Minimum | 220 | 13.2 | 0.05 | 0.01 |
| Maximum | 858 | 150 | 7.41 | 0.74 |
| CV% | 36.77 | 57.51 | 143.15 | 120.4 |

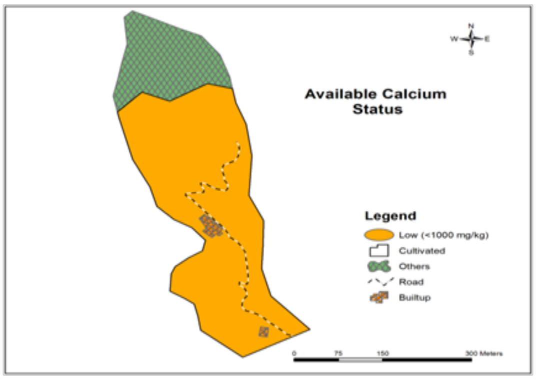


**Figure 9** Available Calcium Status of Chungbang Farm, Pakhribas, Dhankuta, Nepal.

## Available magnesium

Magnesium is a central atom of chlorophyll, and its amount has been found to be 0.2-0.4% of the dry matter in the plants.[43,44] The magnesium content ranged from 13.20 to 150 mg/kg with a mean value of 66.27 mg/kg (Table 5). This reveals medium content of available magnesium (Figure 10), (Table 7). Due to intensive agricultural practices in the farm, there may high possibility of low available magnesium in near future. Therefore, amelioration of soil acidity is a prerequisite solution for increasing magnesium availability in the farm. The variation (57.51 %) in the available magnesium of the observed samples was high.

## Available sulphur

Sulfur is the ninth richest element on the earth's crust, plays a crucial role in the synthesis of chlorophyll, proteins, seeds oil content, as well as amino acids methionine and cysteine in the plants.[45] Sulphur is also a major limiting elements in the different research domains of NARC.[9,10,12,13] The available sulphur varied from 0.05 to 7.41 mg/kg with a mean value of 1.22 mg/kg (Table 5). In overall, available sulphur was very low in status (Figure 11), (Table 7). The high acidity and low content of organic matter in the soil as well as continuous removal of sulphur by the crops due to intense cultivation without adding sulphur element might be the cause of low amounts of sulphur. Therefore, amelioration of soil acidity and organic matter improvement as well as regular use of sulphur fertilizer is imperative for reducing sulphur deficiency stress for the plants. Available sulphur showed high variability (143.15%) in the studied soil samples.

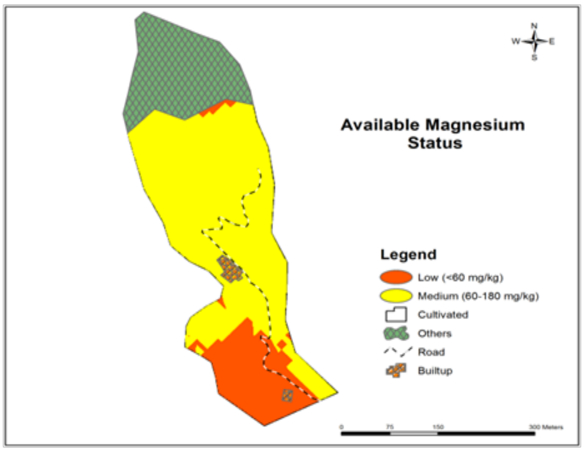


**Figure 10** Available Magnesium Status of Chungbang Farm, Pakhribas, Dhankuta, Nepal

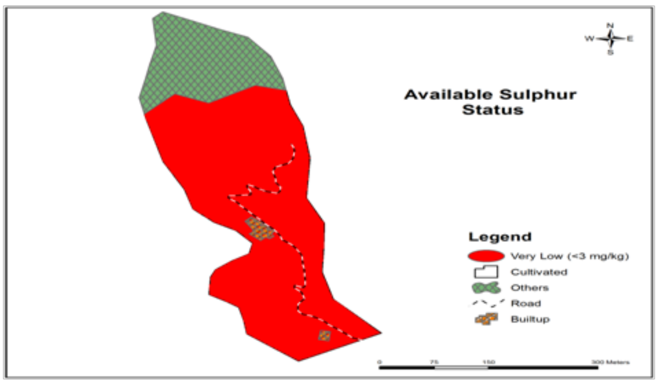


**Figure 11** Available Sulphur Status of Chungbang Farm, Pakhribas, Dhankuta, Nepal.

## Available boron

Amongst the micronutrients, boron is one of the most important micronutrient required for normal growth and development of plant. Boron deficiency has been identified as a serious agricultural issue in more than 100 crops in 80 countries.[46] Similarly, boron is a major limiting elements in the different research farms of NARC.[9,10,12,13] The available boron content ranged from 0.01 to 0.74 mg/kg with a mean value of 0.21 mg/kg (Table 5). This indicates very low content of available boron (Figure 12), (Table 7). The low content of organic

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matter as well as continuous removal of boron by the crops due to intense cultivation without adding boron fertilizer might be the cause of low content of boron. Therefore, organic matter improvement as well as regular application of boron fertilizer is important for reducing boron deficiency stress in the plants. High variability (120.40%) in available boron was observed among the soil samples.

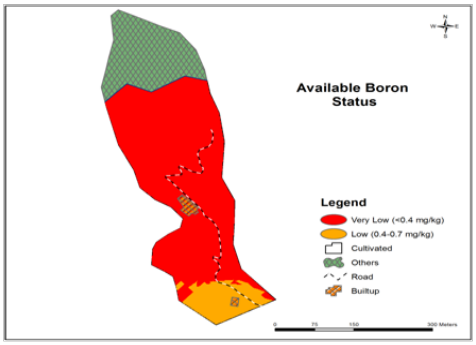


**Figure 12** Available Boron Status of Chungbang Farm, Pakhribas, Dhankuta, Nepal.

## Available iron

Iron is an essential micronutrient for almost all living organisms because of it plays critical role in metabolic processes such as DNA synthesis, respiration, and photosynthesis.[47] Very high content of available iron is also another major limiting factor in the different research sites of NARC.[8–13] The available iron content varied from 4.04 to 64 mg/kg with a mean value of 20.59 mg/kg (Table 6). This shows high status of available iron (Figure 13), (Table 7). Available iron showed high variability (73.44%) among the soil samples.

**Table 6** Soil Fertility Status of Chungbang Farm, Pakhribas, Dhankuta, Nepal.

| Soil Fertility Parameters | | | | |
|---|---|---|---|---|
| Descriptive Statistics | Fe | Zn | Cu | Mn |
| | | mg/kg | | |
| Mean | 20.59 | 0.2 | 2.96 | 31.19 |
| SEM | 2.91 | 0.02 | 0.62 | 2.94 |
| SD | 15.12 | 0.12 | 3.21 | 15.3 |
| Minimum | 4.04 | 0.04 | 0.38 | 1.1 |
| Maximum | 64 | 0.5 | 15.16 | 58.86 |
| CV% | 73.44 | 62.81 | 108.56 | 49.06 |

SEM, Standard error of the mean; SD, Standard deviation

## Available zinc

Zinc is essential in plants for several biochemical processes such as cytochrome and nucleotide synthesis, auxin metabolism, chlorophyll production, enzyme activation, and the maintenance of membrane integrity.[33] Zinc deficiency can be found in every part of the world and almost all crops respond positively to application of Zn.[48] The available zinc content ranged from 0.04 to 0.50 mg/kg with a mean value of 0.20 mg/kg (Table 6). This indicates very low status of available zinc (Figure 14, Table 7). The low organic matter, leaching loss and intense cultivation of crops without adequate application of zinc fertilizer might be the cause of low zinc status. Therefore, different organic and inorganic sources of zinc should be applied in the field regularly to reduce zinc deficiency stress for growing crops. The available zinc showed high variability (62.81%) among the soil samples.

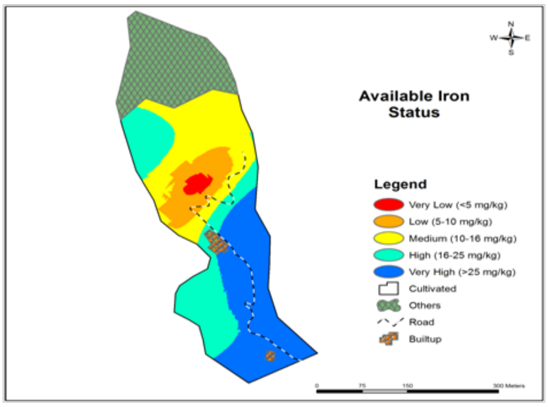


**Figure 13** Available Iron Status of Chungbang Farm, Pakhribas, Dhankuta, Nepal

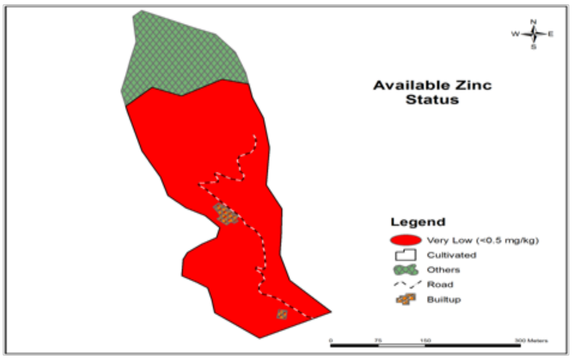


**Figure 14** Available Zinc Status of Chungbang Farm, Pakhribas, Dhankuta, Nepal.

## Available copper

Copper is also an important micronutrient, required for lignin synthesis and acts as a constituent of ascorbic acid, oxidase, phenolase and plastocyanin in plants.[33] The available copper content varied from 0.38 to 15.16 mg/kg with the mean value of 2.96 mg/kg (Table 6). This indicates very high status of available copper (Figure 15, Table 7). High soil acidity might be the cause of very high content of available copper. The very high content of available copper may shows, their toxicity stress for plants. Therefore, amelioration of soil acidity is prerequisite for reducing copper toxicity stress for plants. High variability (108.56%) in available copper was recorded among the soil samples.

## Available manganese

Manganese is also important micronutrients, serves as a cofactor, activating numerous enzymes involved in the catalysis of oxidation–reduction, decarboxylation and hydrolytic reactions in plants.[49] The available manganese content varied from 1.10 to 58.86 mg/kg with a mean value of 31.19 mg/kg (Table 6). This indicates very high status of available manganese (Figure 16, Table 7). The high acidity might be the cause of very high content of available manganese. The very high content of available manganese may shows toxicity stress for plants. Therefore, amelioration of soil acidity is prerequisite for reducing manganese toxicity stress for plants. The available manganese showed moderate variability (49.06%) among the studied soil samples.

**Table 7** Nutrient indices of studied parameters of Chungbang Farm, Pakhribas, Dhankuta, Nepal

| S.N. | Parameters | % Distribution of samples | | | | | Nutrient index | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Very Low | Low | Medium | High | Very High | | |
| 1 | OM | 30 | 67 | 4 | 0 | 0 | 1.04 | Low |
| 2 | N | 7 | 78 | 15 | 0 | 0 | 1.15 | Low |
| 3 | $P_2O_5$ | 0 | 7 | 15 | 30 | 48 | 2.7 | High |
| 4 | $K_2O$ | 15 | 4 | 37 | 41 | 4 | 2.26 | Medium |
| 5 | Ca | 0 | 100 | 0 | 0 | 0 | 1 | Low |
| 6 | Mg | 0 | 48 | 52 | 0 | 0 | 1.52 | Low |
| 7 | S | 92 | 4 | 4 | 0 | 0 | 1.04 | Low |
| 8 | B | 78 | 18 | 4 | 0 | 0 | 1.04 | Low |
| 9 | Fe | 15 | 11 | 22 | 19 | 33 | 2.26 | Medium |
| 10 | Zn | 96 | 4 | 0 | 0 | 0 | 1 | Low |
| 11 | Cu | 0 | 15 | 15 | 33 | 37 | 2.56 | High |
| 12 | Mn | 4 | 0 | 7 | 41 | 48 | 2.85 | High |

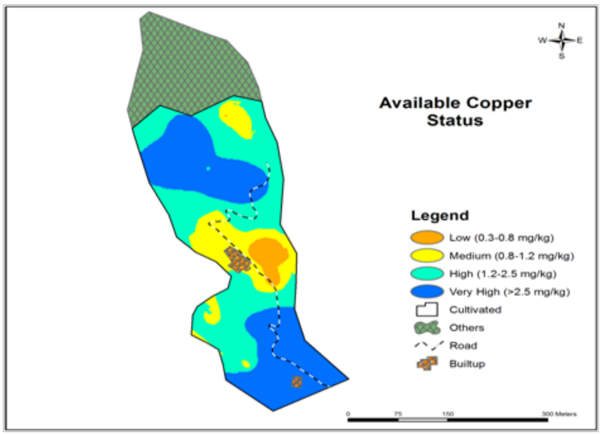


**Figure 15** Available Copper Status of Chungbang Farm, Pakhribas, Dhankuta, Nepal.

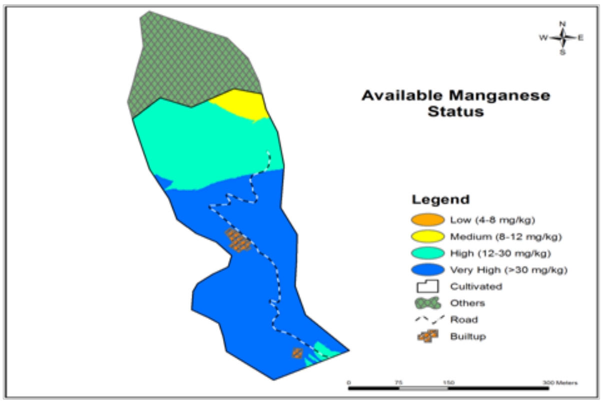


**Figure 16** Available Manganese Status of Chungbang Farm, Pakhribas, Dhankuta, Nepal.

## Conclusion

The research site is appropriate according to the studied physical parameters such as structure, colour and texture. Soil pH is very acidic; causes problem for the nutrient availability, microbial diversity. The amelioration of soil acidity is important for sustainable soil management through reducing negative impact. Similarly, low organic matter is also another constraint in the farm. Adoption of organic matter improvement practice such as organic manure and crop residue incorporation, reduced tillage, crop rotation, mulching, cover cropping etc. is prerequisite. Furthermore, fertilizer should be applied for each crops based on the determined status. If the status is high may have high possibility of low response of applied nutrients, and vice-versa. The plants may suffer from deficiency stress of low and toxicity stress of very high status of nutrients. The specific care should be taken for such types of nutrients. For enhancing research efficacy in the farm, future research strategy should be built based on the determined soil fertility status.

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## Conflict of interest

The authors declared there is no conflict of interest.

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