

Original Research Article

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Nutrient Index Values and Soil Fertility Ratings for Available Sulphur and Micronutrients of Tiruchirappalli District of Tamil Nadu, India

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ABSTRACT

The nutrient index (NI) value for each of the nutrients is computed for the fourteen blocks of Tiruchirappalli district from the percentage of samples that falls under the category of high, medium and low. The NI value (2.17- 2.87) for available S, in the most of blocks of Tiruchirappalli district was recorded the high nutrient index value. The nutrient index value (1.43-2.50) for DTPA-Cu was very low in Thirupparankundram, Melur, Chellampatty and Alanganallur, in case of Manikandam block was falls in high category. The NI value (1.33-2.34) of available Zn was found very low in the most of blocks, marungapuri block showed high NI value. The NI values (2.54 to 3.00) for manganese was found in Thiruverumbur and Marungapuri block with high nutrient index value. The NI values (2.35-2.89) for DTPA-Fe was found that high in Thiruverumbur block, all the remaining blocks fall under very high category. The NI value for boron was recorded as (1.67 -2.56). Regarding fertility rating class in Tiruchirappalli district, the available zinc and copper were very low. The available manganese, iron, sulphur and boron were found to be under high category.

Keywords

Nutrients index values, Soil fertility rating, Available sulphur, Micro nutrients

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Introduction

Agriculture is a very important sector for sustained growth of Indian economy. About 70 percent of rural households and eight percent of urban household are still dependent on agriculture for employment. Soil is the basic natural resource for crop production and it supplies essential nutrients for plant growth, the food security and necessary components of human and animal food and the nutritional

security of the country. However continuous cropping of high yielding varieties without proper substitution of inorganic fertilizers, non-addition of micronutrients, and less or no application of organic manures have caused excessive removal of essential nutrients from the soil reserves that eventually led to the deficiencies of micronutrients in soils. The deficiency may either be primarily due to their low contents or secondarily by soil factor that reduce the availability (Sharma and

Chaudhary, 2007). Global Positioning System (GPS) and Geographical Information System (GIS) helps in collecting a systematic set of geo-referenced samples and generating spatial data about the distribution of nutrients (Sharma, 2004). The GPS can be effectively used in conducting survey for updating the existing base maps and mapping the extent of spread of disease in crops and its monitoring (Sood *et al.*, 2004). Hence, the estimation, characterization and comparison of spatial variation of micronutrients are important issues in the site-specific crop management, precision farming and sustainable agriculture (Nayak *et al.*, 2006).

Soil nutrient maps covering large areas improve understanding of the nature and extent of nutrient problems, and aid in determining their relationships with climate, soil properties, and soil genetic characteristics determined at similar scales. Intermediate scale maps can be useful in delineating specific areas where deficiencies or toxicities are likely for agriculture, and in determining localized soil characteristics that may be associated with such problems. The thematic maps for individual nutrient (Zn, Fe, Cu and Mn) is prepared by using GIS software (Minakshi *et al.*, 2005 and Nayak *et al.*, 2006) and multi micronutrient maps are generated by integrating individual maps of Fe, Mn, Zn and Cu in the GIS (Sood *et al.*, 2004). This will also help in monitoring changes in micronutrient status over a period of time. It can be revisited with help of GPS, which is otherwise not possible in the random sampling.

Materials and Methods

The geo-referenced surface soil samples were collected from the villages of Tiruchirappalli district to assess the available sulphur and micronutrient status.

Description of study area

The present study area comprises the Tiruchirappalli district consisting of 14 blocks. Major portion of the district is covered by plain topography. Gneissic group of rocks of Archean period consisting of granitoid mica gneiss, granitic gneiss leptinites, mixed and composite gneiss are found at different places. The dominant minerals found in the district are limestone, gypsum, garnet sand and limonite. The crystalline lime stones of Precambrian age are mainly distributed in parts of Tiruchirappalli. Deep black is the predominant soil in the district accounting for 32.2 percent followed by the deep red soil with 25.12 percent.

Collection and processing of geo-referenced surface soil samples

Totally 1584 geo-referenced surface soil samples covering all the villages in fourteen blocks of Tiruchirappalli district were collected randomly at 0 - 15 cm depth by adopting the standard procedures of soil sample collection. The Global Positioning System (GPS) data (Eastern Longitude and Northern Latitude) were collected from each sampling sites distributed over the entire Tiruchirappalli district by using GPS.

The collected soil samples were air dried, gently bound, sieved (2 mm sieve) and preserved in serially labeled polythene bags for further analysis. Locations of soil sampling sites of Tiruchirappalli district were marked on base map 1: 50,000 scale prepared from State Revenue Maps and digitized using Arc-GIS.

Nutrient index values and fertility rating

Nutrient Index Value was calculated from the proportion of soils under low, medium and high available nutrient categories, as represented by

$$\text{NIV} = \frac{[(P_H * 3) + (P_M * 2) + (P_L * 1)]}{100}$$

Where,

NIV = the Nutrient Index Value

P_L , P_M and P_H are the percentage of soil samples falling in the category of low, medium and high nutrient status and given weightage of one, two and three respectively (Ramamoorthy and Bajaj, 1969)

The index values are rated into various categories *viz.*, very high (> 2.66), high (2.33-2.66), adequate (2.00-2.33), marginal (1.66-2.00), low (1.33-1.66) and very low (< 1.33) for the nutrient supply.

Classification of nutrient index value

< 1.33 = Very low 1.33 - 1.66 = Low
1.67 - 2.0 = Marginal 2.0 - 2.33 = Adequate
2.33 - 2.66 = High > 2.66 = Very high

Results and Discussion

The present study was conducted with the major objectives of assessment of nutrients Index value and fertility rating each block in Tiruchirappalli district for available Sulphur and micronutrient.

Nutrient Index value and fertility rating at district level

The nutrient index (NI) value for each of the nutrients is computed for the fourteen blocks of Tiruchirappalli district from the percentage of samples that falls under the category of high, medium and low. Based on the NI values, the fertility rating of district is classified as very low (<1.33), low (1.33 - 1.66), marginal (1.66 - 2.0), adequate (2.00 - 2.33), high (2.33 - 2.66) and very high (>2.67).

Available sulphur

The NI value for available S ranged from 2.17 to 2.87 and rated as high. Most of the blocks of Tiruchirappalli district recorded the high nutrient index values with respect to available S considering the critical limit of Sulphur as 10 mg kg⁻¹.

Available copper

The NI values for Cu ranged from 1.43 to 2.50. The nutrient index values for DTPA-Cu were very low in Thirupparankundram, Melur, Chellampatty and Alanganallur. While it was low in Andanallur, Uppliapuram blocks. The other blocks *viz.*, Lalgudi, Pullambadi, Manachanallur, Musiri, Thathayangarpettai and Thiruverumbur blocks were in marginal. Others remaining were categorized under adequate scale. Manikandam block falls in high category.

Available Zinc

The NI value of Zn ranged from 1.13-2.34. The nutrient index values of available zinc were found to be very low in most of the blocks of the district. Marungapuri block showed high nutrient index value.

Available manganese

The NI values for manganese ranged from 2.54 to 3.00. Thiruverumbur and Marungapuri block was found to be with high nutrient index value. All the remaining blocks showed very high nutrient index values.

Available iron

The NI value for DTPA-Fe ranged from 2.35 to 2.89. The nutrient index values of DTPA-Fe were found to be high in Thiruverumbur block. All the remaining blocks fall under very high category.

Fig.1 Nutrient index rating for available Sulphur in the soils of Tiruchirappalli District
Nutrient index rating classes for available Sulphur

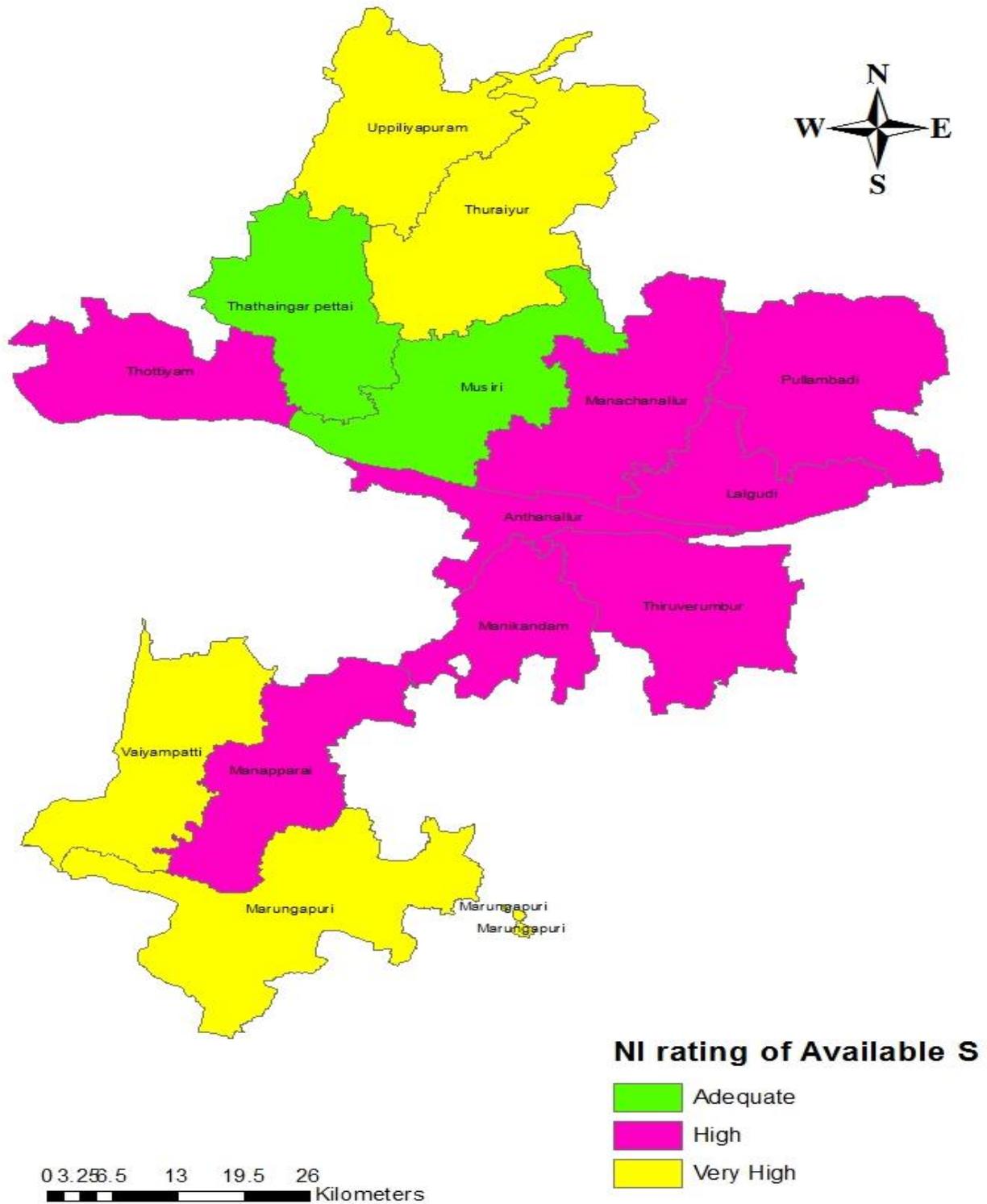


Fig.2 Nutrient index rating for available Copper in the soils of Tiruchirappalli District

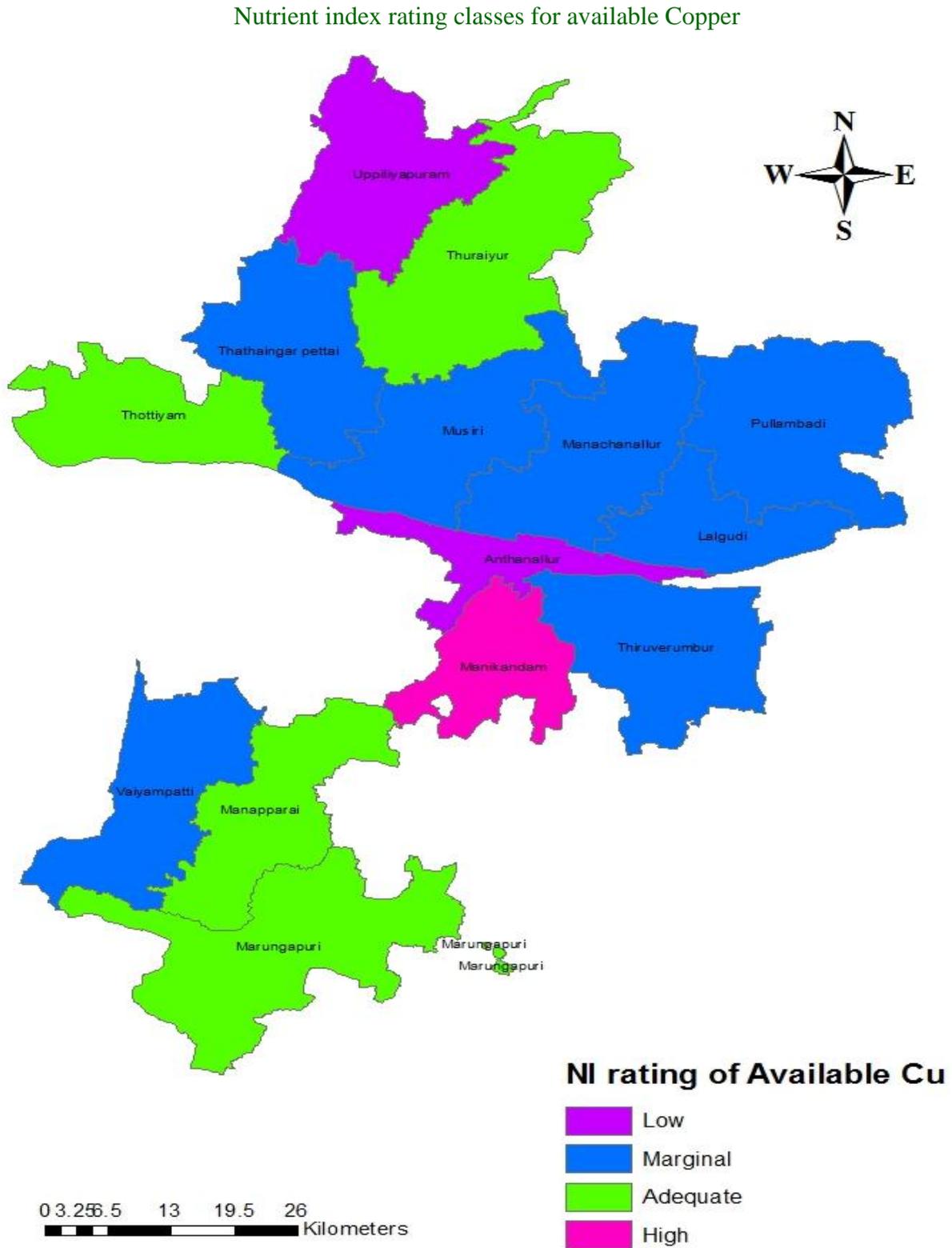


Fig.3 Nutrient index rating for available Zinc in the soils of Tiruchirappalli District

Nutrient index rating classes for available Zinc

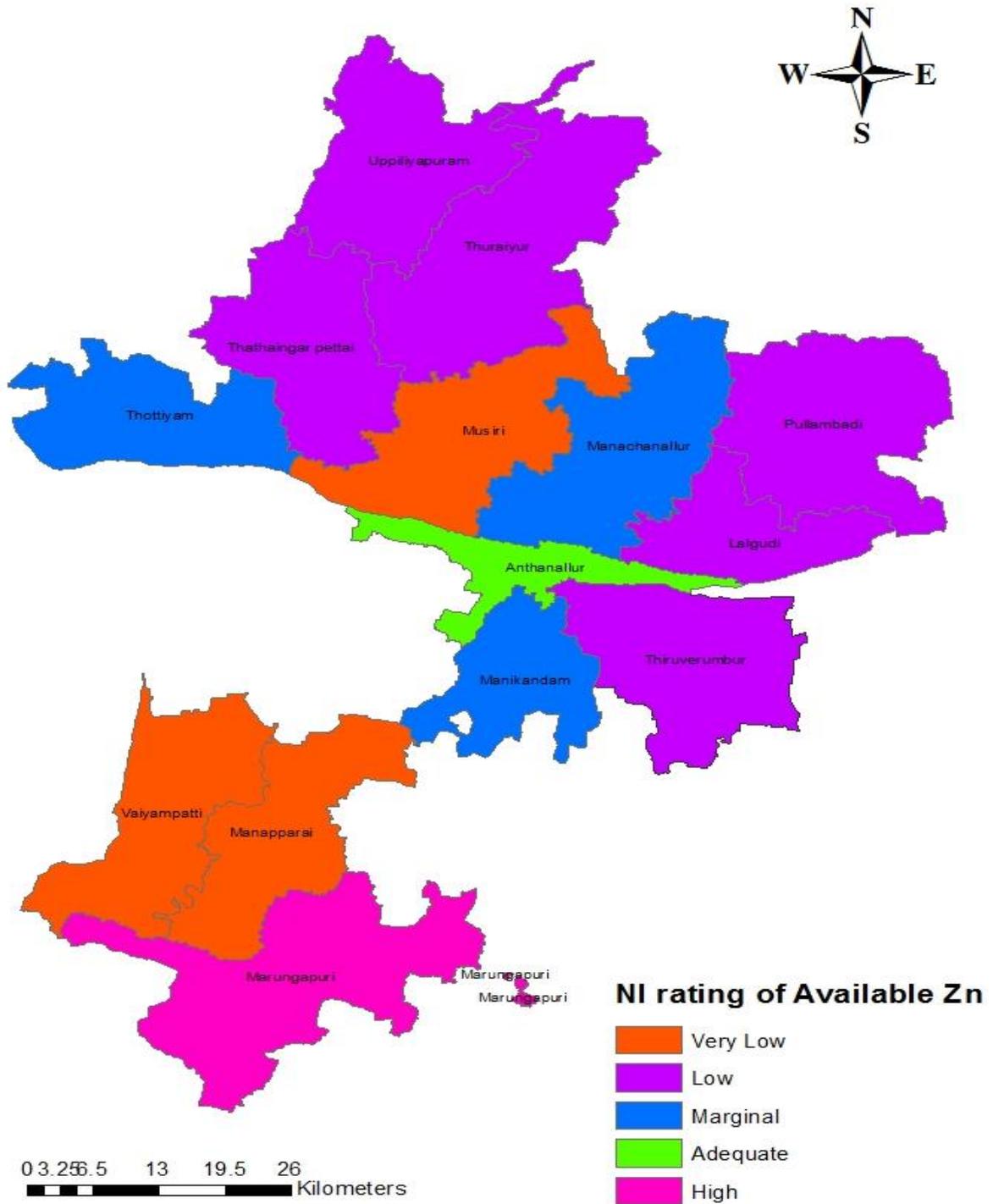


Fig.4 Nutrient index rating for available Manganese in the soils of Tiruchirappalli District

Nutrient index rating classes for available Manganese

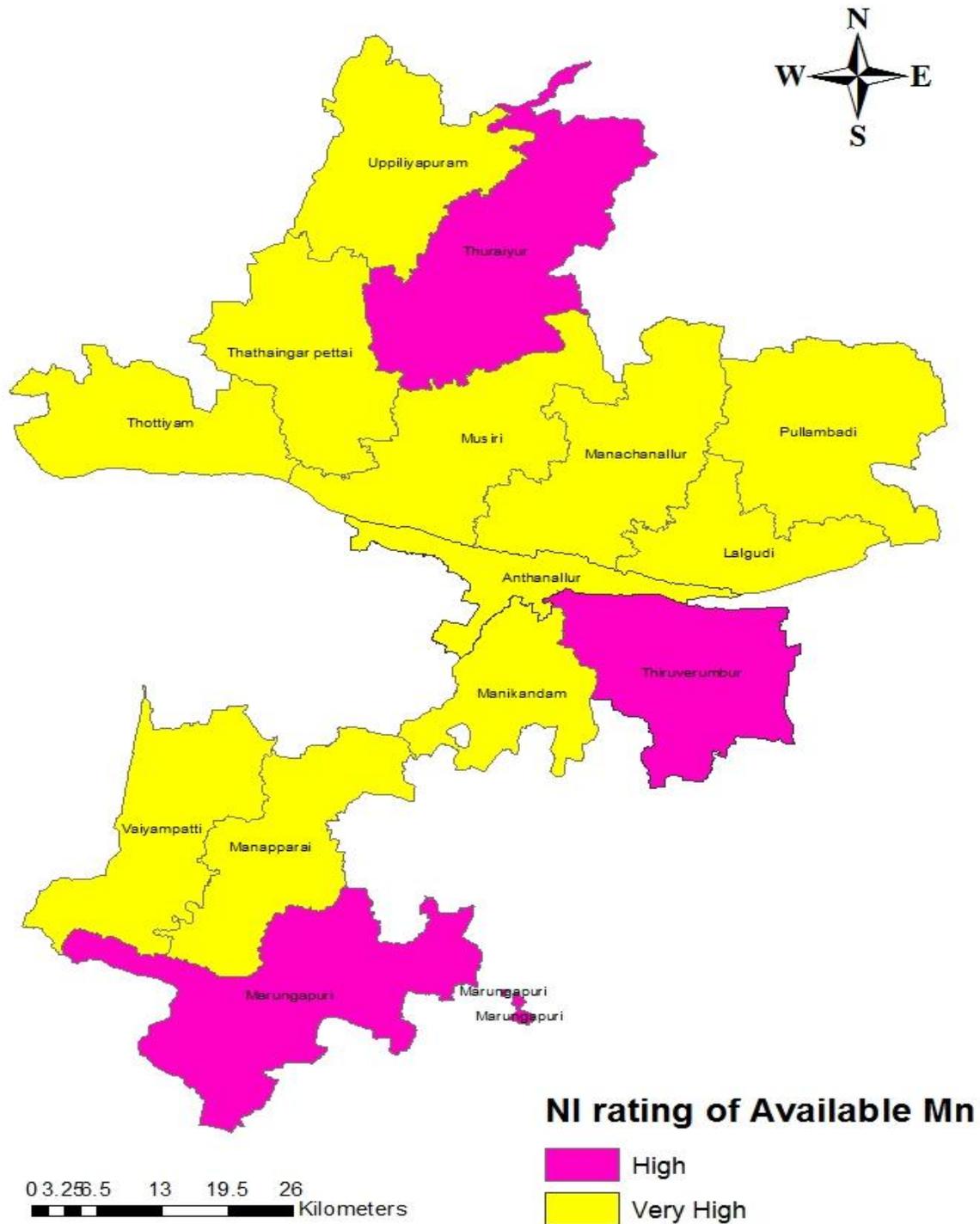


Fig.5 Nutrient index rating for available Iron in the soils of Tiruchirappalli District

Nutrient index rating classes for available Iron

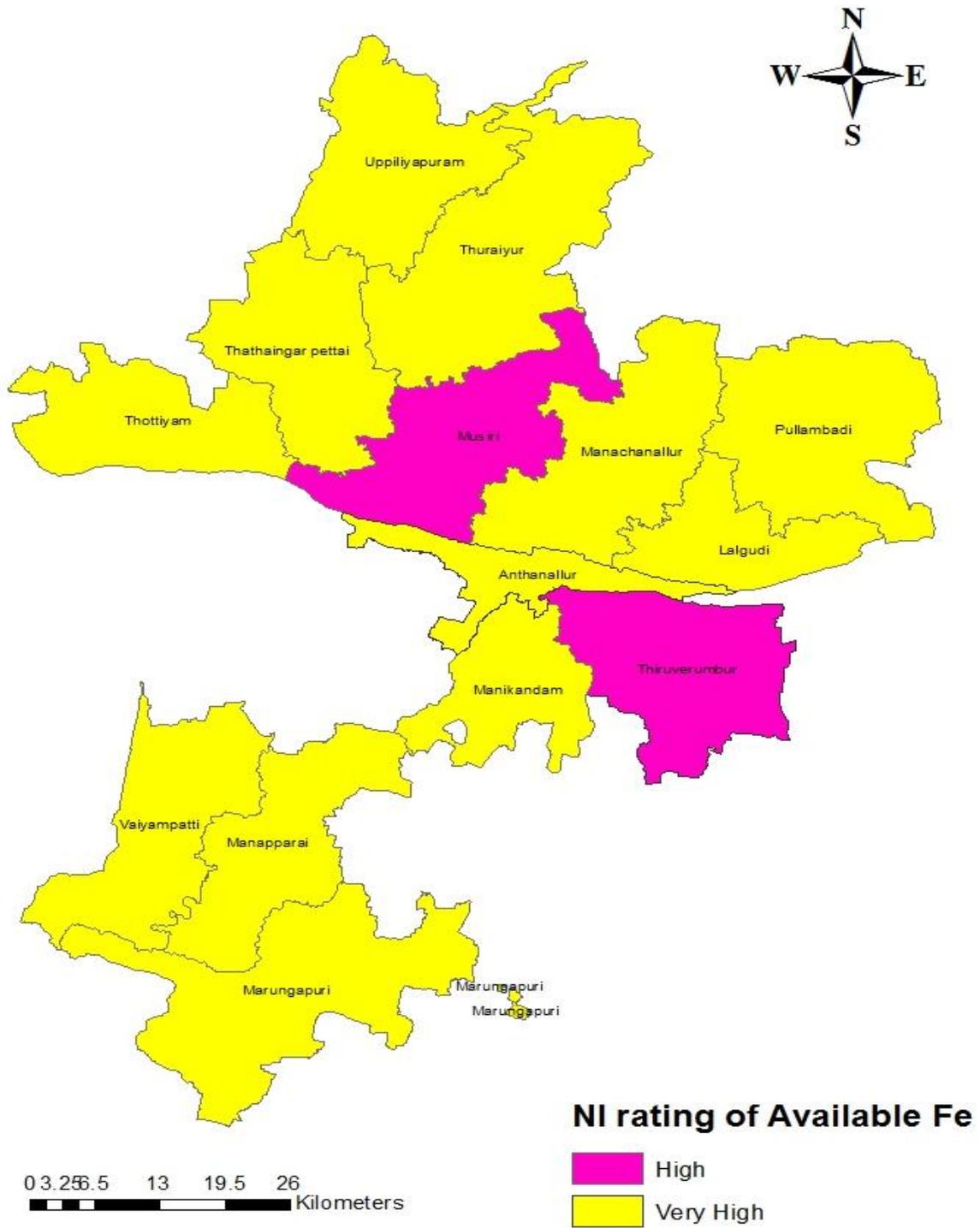
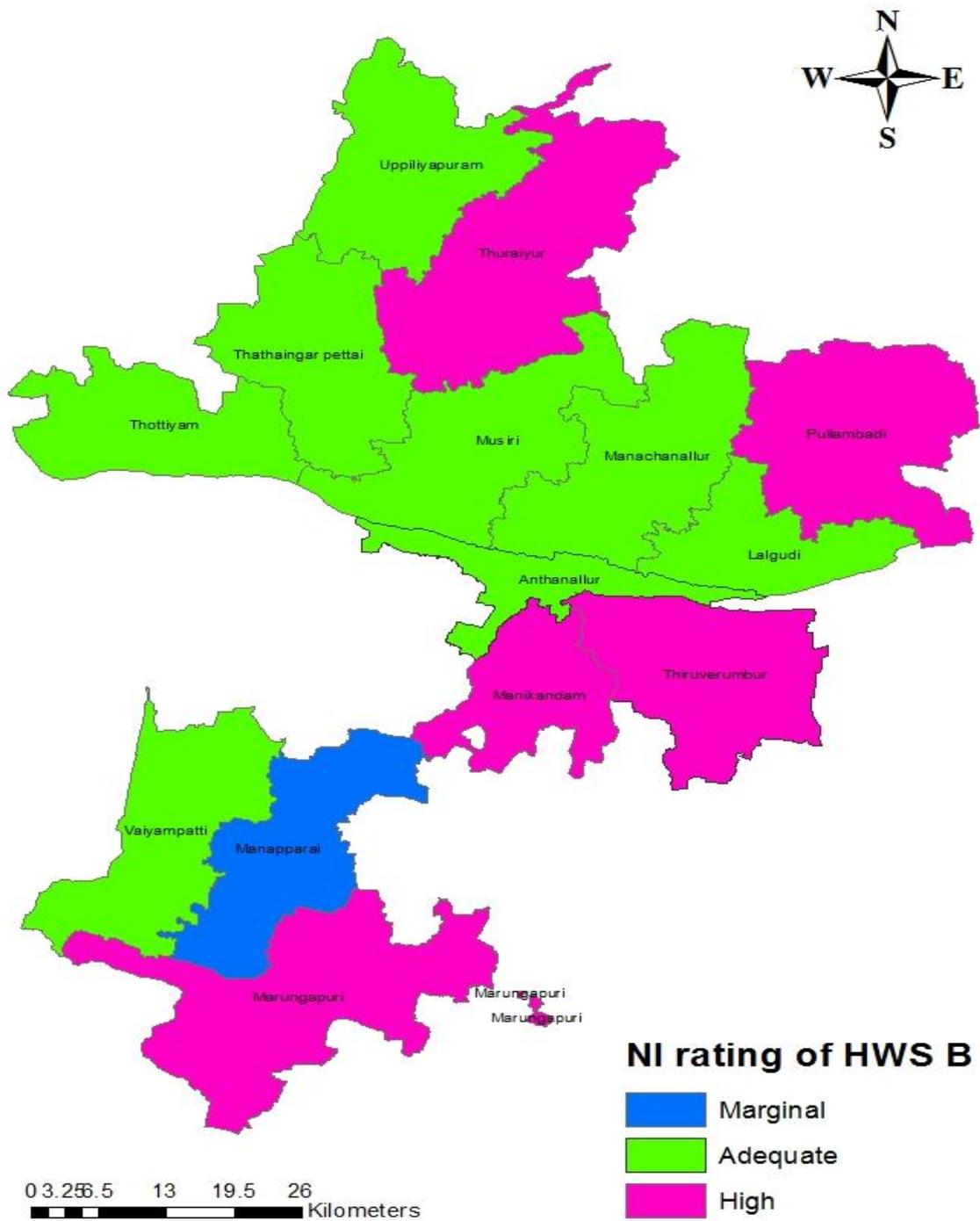


Fig.6 Nutrient index rating for available boron in the soils of Tiruchirappalli District

Nutrient index rating classes for available Boron



Hot water soluble boron

The NI value for boron ranged from 1.67 to 2.56. The fertility status of available boron was found to be high in Pullambad, Marungapuri, Manikandam and Thiruverumburi. All the remaining blocks fall under adequate category.

Nutrient index values refers to the rating of nutrients based on their critical values and based on the NI values, the soil fertility is rated as low, medium and high.

The critical limits of different nutrients are 10 - 15 mg kg⁻¹ for S, 1.2 - 1.8 mg kg⁻¹ for DTPA-Cu and DTPA-Zn, 2 - 4 mg kg⁻¹ for Mn, 3.7 - 8.0 mg kg⁻¹ for DTPA-Fe and 0.46 - 1 mg kg⁻¹ for HWS-B (Anon, 2003). Ramamoorthy *et al.*, (1969) gave the NI ratings based on percentage of samples under low, medium and high category. By considering these ratings the data for Tiruchirappalli district were grouped as very low, low, marginal, adequate, high and very high.

Available S was found to be very high in Tiruchirappalli district which may be due to presence of free gypsum in soil profile (Sahrwat *et al.*, 2007).

The fertility rating was high for DTPA-Mn and it was high and very high for DTPA-Fe in the entire district. It might be due to the fact that all these areas are rice growing belts; where under submerged conditions, Fe³⁺ is converted into ferrous form which is more available and easily soluble in water. In case of Mn, increase of Mn (II) indicating that Mn oxides in the soil phase serves as an electron acceptor (Lu *et al.*, 2004) by some fungi and certain organic compounds synthesized by some microbes or plants, as root exudates having oxidising and reduction powers. These results corroborate with the findings of Meena *et al.*, (2006).

The fertility status of HWS-B is found to be adequate, as soils around neutral pH. Berger and Troug (1944) reported that availability of boron was comparatively more between pH 6.0 to 8.0 and it decrease below and above this range.

Conclusions of the study are as follows

Almost 64 per cent of the soils was deficient in available Zn (63.82%) followed by available Cu (40.11%), HWSB (16.18%) and available sulphur (11.59%). Nearly 90 percent of the soils of Tiruchirapalli district were sufficient in DTPA-Fe and DTPA-Mn.

By comparing the thematic maps of available nutrient status and fertility rating map based on nutrient values, the more number of classes were obtained in nutrient map. It will be useful for delineating the blocks which are deficient or the areas amenable for deficient in ensuring period. This also help in site specific crop oriented micronutrient application for ensuring crop growth.

Thus, from the above investigation it is very clear that the soils of Tiruchirapalli district are deficient in DTPA-Cu and Zn. Therefore to overcome these deficiencies of these nutrients it is necessary to supply these nutrients either organically or inorganically. The availability of B is sufficient in general and required to be applied in specific situations as per need.

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