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# Application of GIS in the Soil Quality Analysis of North-Eastern block of Sandur Taluk, Ballari District, Karnataka, India

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***Abstract*— A good agricultural research and guidance programme includes a soil survey. It contains detailed information about soils and serves as an inventory of the area's soil resources. It provides the data required to plan land use and soil management programmes. In the present study, we created the Soil Quality map of the North-Eastern Block of the Sandur Taluk, Ballari District of Karnataka using QGIS software. During November 2022, Eleven soil samples were collected from the agricultural area of study area. The soil survey report and field samples were used to create a database of soil characteristics. The soil survey report is based on a low intensity survey, but it can be used for a variety of planning purposes, so it is used to demonstrate the utility of GIS in soil data analysis and interpretation. Soil quality evaluation is useful for agricultural production. Agriculture is the driving force behind a developing country's economy, and soil quality is the most important factor in this regard. Industrialization has a negative impact on agriculture all over the world. Mining added new environmental hazards and risks.. Different land use types and topographic aspects were used to compare soil organic carbon, phosphorus, potassium, iron, and PH. The differences in these soil indicators under different land use types in the Sandur Taluk's North-Eastern Block were tried to explain by the influence of slope, elevation, farming system, or soil texture.**

**Keywords— RS and GIS, North-Eastern Block, Soil Quality analysis.**

## I. INTRODUCTION

The continued advancements in industrialization, as well as the ever-increasing demand for minerals, have resulted in an increase in mining activities, which has resulted in ecological imbalances and a variety of environmental hazards such as soil, water, and air pollution (Sheoran 2011;Vamerali et al. 2010; Wu et al., 2007 ).

A good agricultural research and advisory programme includes a soil survey. It contains detailed information about soils and serves as an inventory of the area's soil resources. Agriculture is the foundation of the Indian economy. To produce food for an expanding population, land and water resources must be used in a more sustainable manner. Soil and water are the two most important components of the agricultural system, and they are deteriorating in many ways. Soils are deteriorating due to erosion, water logging, salinity, and other factors. As a result, understanding soils is critical for any project planning in order to meet environmental requirements. Soil serves as a water filter and a growing medium for billions of organisms, contributes to biodiversity. Soil is the foundation of our earth's natural food-producing agroecosystems. The fertility parameters in agricultural lands deteriorated due to mining and its associated activities, according to the soil quality status analysis performed in the study area. After evaluating the key parameters, it was discovered that mining land had the lowest organic carbon, followed by agriculture, indicating that top soil is being lost due to mining and agricultural activities.

The majority of the net irrigated area in the current study area is supplied by ground water. As a direct result of open pit mining operations, soil is destroyed over a large area. As a direct result of open pit mining operations, soil is disrupted over a large area. One of the most visible environmental hazards associated with abandoned mine lands is metal contamination of soil. Humans and wildlife can be affected by heavy metals through drinking water and inhaling contaminated air or soil from mining activities.

## II. STUDY AREA

The present Soil Quality Analysis Mapping is carried out for the North-Eastern Block which lies in the Sandur taluk of Ballari district in the State of Karnataka. it is located between 15.257787°N and 15.088812°N in latitude and 76.356183° E and 76.607385°E in longitude, and is covered by an area of 165 Sq.km. Fig.1 depicts a location map of the Study area.

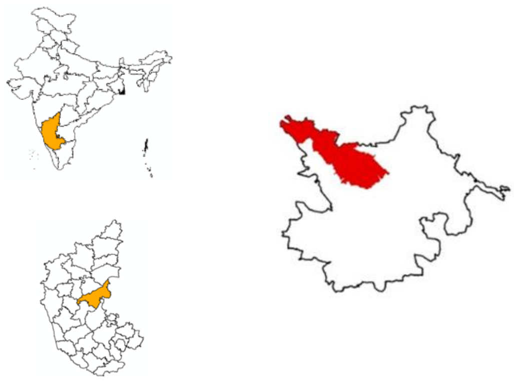

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Figure 1: Location map of the study area.

## III. METHODOLOGY

The base map of the study area has been prepared from the 1:50,000 scale Survey of India (SOI) toposheets number 57 A/8, 57 A/12, 57 B/5, and 57 B/9. Eleven soil samples have been taken in the month of November 2022 for analysing the soil quality of the North-Eastern Block of the Sandur Taluk using Inverse Distance Weighted method in QGIS software and relevant maps were prepared. Fig.2 shows a flow chart depicting the methodology adopted for the Soil Quality mapping of the present Study area.

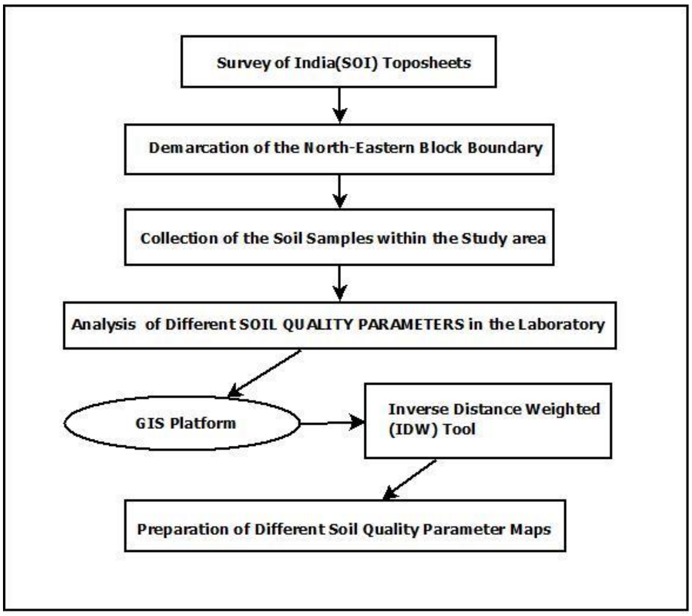


Figure 2. Flow chart representing the Methodology adopted for the present Study.

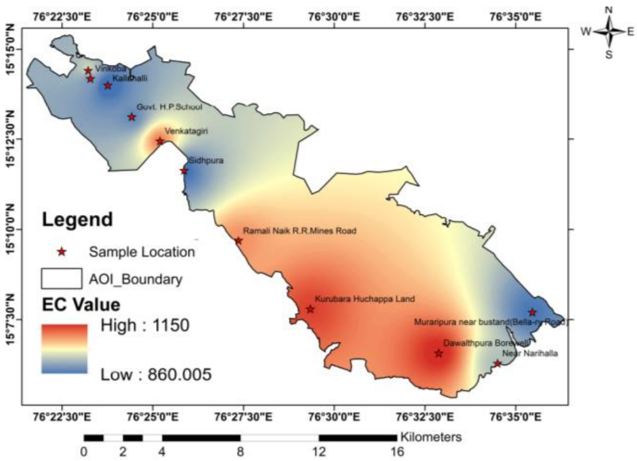


Figure 3. Map showing EC in soil

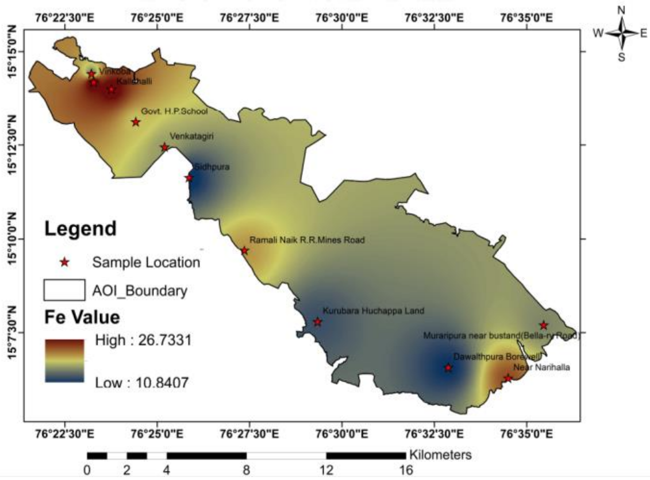


Figure 4. Map showing Iron concentration in soil

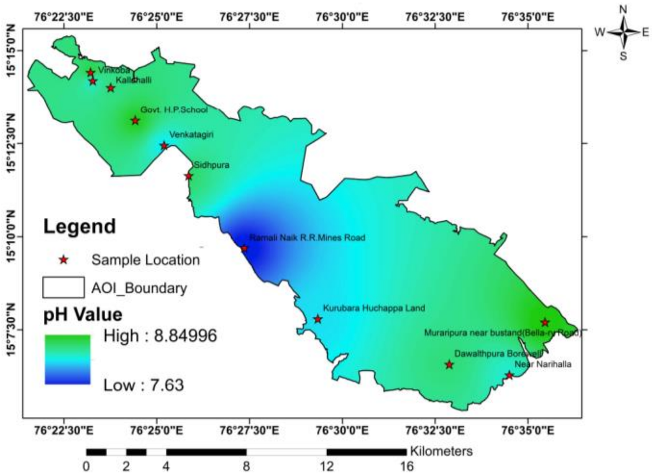


Figure 5. Map showing pH in soil

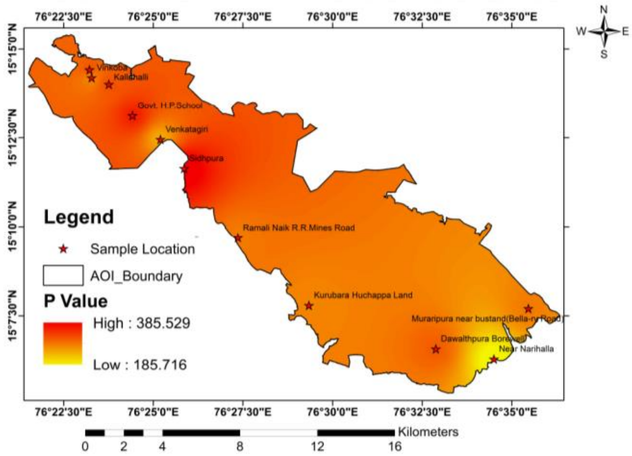


Figure 6. Map showing Concentration of Phosphorus in soil

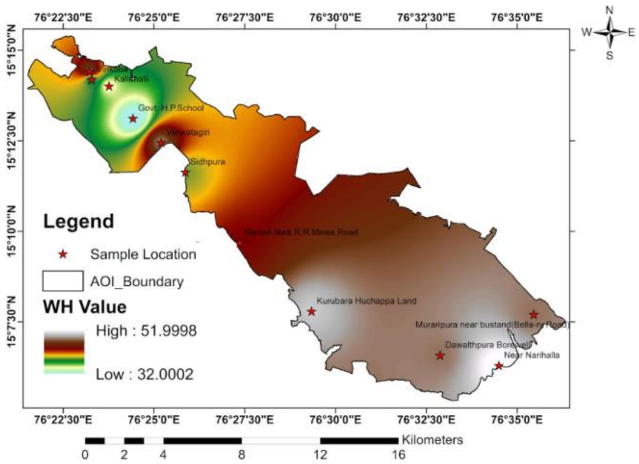


Figure 7. Map showing water holding capacity in soil

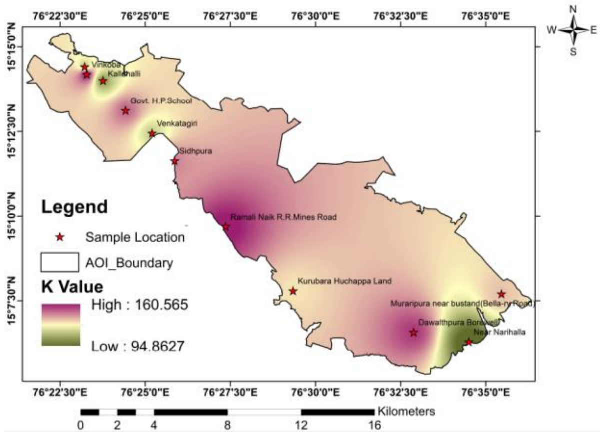


Figure 8. Map showing Concentration of Potassium in soil

1:5 soil:water suspension. Micromhos per centimetre (mhos/cm) is the unit of measurement for conductivity. The soil in the study area has a high electrical conductivity in the southern part of the study area and a low electrical conductivity in the northwestern part of the study area.

### Iron concentration in soil

According to Bodek et al. (1988), the typical range of iron concentrations in soils is from 0.2% to 55% (20,000 to 550,000 mg/kg). Native iron concentrations vary significantly across regions and even within localised areas due to soil types and the presence of other sources. We noticed that the southern part of the Narihalla reservoir has a low concentration of iron content, while some areas near the reservoir have a high concentration of iron.Because of the influence of many iron mines in that part of the study area, the northwestern side of the study area has high iron concentration.

### Concentration of pH in soil

The typical pH range for soil is 4.0 to 8.0; the ideal pH range for plant nutrient availability is 6.0 to 7.0. s the soil to water ratio rises, the pH of acidic soils slightly rises. With saturated paste, soil pH will be slightly below 1:1, which will result in a slightly lower soil-to-water ratio than 1:2.We are using a 1:2 aqueous solution here.Fig 5 shows the pH of the study area.

### Concentration of Phosphorus in soil

Phosphorus (P) is a necessary nutrient for plant growth. After nitrogen (N), it is the second most limiting macronutrient. Inadequate P nutrition causes plant maturity to be delayed and yield to be reduced. In many soils, phosphorus (P) can limit crop production, and soil testing is used to guide fertiliser recommendations. Excessive soil phosphorus reduces the plant's ability to absorb essential micronutrients, particularly iron and zinc, even when soil tests show adequate levels of those nutrients. Phosphorus concentrations in soil range from 185.716 Kg/Hec to 385.529 Kg/Hec. in the study area,We found a high concentration of Phosphorous near Sidhapura village, while agriculture land near Narihalla has a lower concentration.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coordinates** | 15.1049º<br>76.5747º | 15.1096º<br>76.5479º | 15.1299º<br>76.4892º | 15.1614º<br>76.4564º | 15.1939º<br>76.4306º | 15.2075º<br>76.4197º | 15.2187º<br>76.4073º | 15.2335º<br>76.3958º | 15.236º<br>76.387º | 15.2403º<br>76.3871º | 15.2403º<br>76.3871º |
| **Place** | Narihalla | Krishnan agara agri land | Dawlathp ura | RR Mines road | Sidhapur a | Venkatag iri | Govt. H.P.Scho ol | kallahalli | Vinkoba Agri.lan d | Kaniveray a temple | Muraripu ra |
| **pH** | 8.34 | 8.56 | 8.21 | 7.63 | 8.60 | 8.25 | 8.79 | 8.54 | 8.32 | 8.73 | 8.85 |
| **EC** | 960 | 1150 | 1130 | 1080 | 880 | 1090 | 910 | 860 | 920 | 990 | 890 |
| **P** | 185.71 | 300.00 | 271.43 | 278.57 | 385.71 | 242.85 | 342.86 | 307.14 | 264.28 | 307.14 | 278.57 |
| **K** | 94.86 | 154.78 | 132.48 | 160.02 | 144.30 | 120.84 | 148.32 | 110.54 | 160.87 | 118.32 | 136.74 |
| **Iron** | 21.89 | 11.28 | 12.85 | 19.55 | 10.83 | 16.20 | 18.21 | 25.47 | 26.81 | 14.41 | 15.30 |

Table 1. Table showing Soil Quality Analysis Report of the Study area(*pH (1:2 aqueous solution), EC(Electrical Conductivity -µmhos/cm), Phosphorus (P) Kg/Hec, Potassium (K) Kg/Hec, Iron (Hcl Solubles %)

## IV. RESULT AND DISCUSSION

### Soil electrical conductivity (EC)

Soil electrical conductivity (EC) measures the amount of salts in the soil (salinity). It measures nutrient availability and loss, soil texture, and available water capacity. The electrical conductivity of soil indicates the concentration of soluble (salt) ions. Electrical conductivity (EC) is determined using a conductivity cell by measuring the electrical resistance of a

### Water-holding capacity in soil

Water-holding capacity (WHC) (also known as water-binding capacity or water-absorption capacity) is a measurement of how much water can be absorbed per grammes of protein powder. This property is based on protein molecules' direct interaction with water and other solutes. An excessive amount of water can also be a problem, resulting in standing water, erosion, and nutrient loss. Soil texture and organic matter have the greatest influence on water-holding capacity. Smaller particle soils (silt and clay) have a larger surface area than larger sand particles, and a larger surface area allows a soil to hold more water. Knowing the soil's capacity to hold water is crucial for estimating the field's water storage capacity and determining how much supplemental irrigation is necessary.In the study area we see that south eastern part have more water holding capacity compared to other parts of the study area.

**Concentration of Potassium in soil**

Potassium is an essential plant nutrient that must be consumed in large quantities. Potassium Increases root growth and resistance to drought. Maintains turgor while decreasing water loss and wilting. Contributes to photosynthesis and food formation. Reduces respiration and thus energy loss. Potassium concentrations in soil range from 94.8627 Kg/Hec to 160.565 Kg/Hec. We noticed that the south-eastern and northwestern edges of the study area have low potassium concentrations, while the central region has a higher potassium concentration.

## V. CONCLUSION

Based on the analysis results, a geographical representation of different soil quality parameters was created in the current study using the GIS platform. Soil quality information is essential to proper soil resource planning and crop management in agricultural lands. According to the soil quality status analysis performed in the study area, mining and its associated activities have deteriorated the fertility parameters in agricultural lands. Following an analysis of the key parameters, it was discovered that mining land had the lowest organic carbon, followed by agriculture, indicating that top soil is being lost as a result of mining and agricultural activities.Sandur Taluk, Ballari District, Karnataka, in the north-eastern block.

The type of nutrients present in the soil has an impact on crop growth and yield. The soil quality in the current study area is gradually deteriorating due to mining.It also has a negative impact on agricultural activities. Using new techniques to improve soil quality is therefore essential. This soil Quality map also includes information about the current soil Quality in the Research area.

Agriculture in the study area requires soil quality and agricultural productivity improvements. The economic gain from leasing agricultural land to mining activity is one of the primary reasons for farmers' loss of interest in agriculture. The agricultural area of Sandur taluk has shrunk significantly over the years. The combination of reduced cultivable land and mining on agricultural lands will have a significant impact on agriculture in the near future. The reclamation of land after mining operations must be taken seriously. Because dust pollution reduces crop productivity and yield, it should be reduced. Green and farmyard manure, as well as vermicompost manure, must be used instead of chemical fertilisers for sustainable agriculture. Pesticides must be phased out in favour of less harmful biological pest control methods.

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