Abstract

ABSTRACT

SPATIAL PREDICTION OF SOIL ORGANIC CARBON FROM LEGACY SOIL DATA

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Soil organic carbon is one of the important indices in controlling soil properties. It influences the soil structure, moisture retention, nutrient turnover, cation exchange capacity, degradation of pollutants, suppression of greenhouse gas emission and improves soil buffering. Soil organic carbon (SOC) is an important attribute and it is the most important indicator of soil quality and agricultural sustainability, maintaining sufficient soil organic carbon is a key to improve soil fertility, productivity and in turn environmental sustainability. Studies indicate a declining SOC in Tamil Nadu especially districts like Coimbatore. The concept of soil mapping will provide an insight into the various properties of soil at spatial scale which are required to analyze various potentials and limitations. The conventional method of soil organic carbon estimation is highly laborious and time consuming. Also, there were lots of problems associated with data consistency and data handling in the process of traditional mapping Advancement in remote sensing, geocomputation and geostatistics has paved way to the concept of Predictive soil mapping. Predictive soil mapping can be interpreted as development of a numerical or statistical model in order to establish a relationship between environmental variables and soil properties which is then applied to geographic data base.

The present study concentrated on digital soil mapping of soil organic carbon of the Coimbatore district. The legacy soil data, profile information and soil maps were used as a input for soil mapping along with limited survey. A total of 218 profile information were collected from the existing maps and a total of 222 profile information were collected from actual profile observations to arrive at a grand total of 440 soil profile information. The information thus obtained from different sources were grouped into different soil organic carbon (SOC) status categories *viz*., low, medium and high. The ground truth collected soil data used as a dependent variable and remote sensing, terrain analysis and environmental data as independent variables to extract knowledge base for predictive soil mapping. The data mining technique used in the present study is decision tree model. See5 algorithm derives rules for a complete decision tree to predict soil organic carbon. Using the See5 classifier option available in the NLCD tool, soil class layer and error or confidence layer was generated. Out of 440 points, 348 and 92 points were used as training and testing data, respectively.

Out of 33 co-variants studied, only 16 co-variants were found to be useful for the decision tree analysis. Physiography was found to be the most influencing factor with a weightage of 99 per cent. This is followed by the green spectral band of satellite data and geomorphology which had a influence of 12 and 11 per cent, respectively.

Accuracy assessment of the map was done by comparing the classes allocated in the classified image to their corresponding classes in the “test” file. The error matrix approach is most frequently used in accuracy assessment. The predicted map produced an overall accuracy of 89.13 per cent. The producer’s accuracy was highest for the medium soil organic carbon class (98.08) followed by high (91.30) and the lowest being low soil organic carbon (58.82). The user’s accuracy has shown a different pattern, with low soc content having 100% accuracy followed by medium (87.93) and high class (87.50). The kappa statistic determined from the overall error matrix was 0.81 indicating high accuracy in mapping.

It was concluded from the map that almost 56 percent of total area of the Coimbatore district comes under the medium soil organic carbon status. The high organic carbon status tends to occur at around 30 percent of total area and the low

organic carbon is just 6 percent of the total area. Block wise soil organic carbon map was derived from the final soil organic carbon map and it was concluded that, out of total area under high organic carbon, a maximum share of 29.46 percent comes under Annamalai block. Pollachi South (0.79%) and Sarkarsamakulam (1.0%) occupies the least area under high soil organic carbon status. The Pollachi South (12.20%), Kinathukadaku (11.43%) and Thondamuthur(10.69%) takes considerably large areas under low organic carbon status. These areas are under continued cultivation. There are many strategies available or being adopted at farm level to maintain or to improve the SOC content.

Thus, the digital soil mapping using existing soil point data, environmental covariates, machine-learning models and algorithms, and the expert knowledge paved a way to overcome the snag associated with conventional mapping. Hence, the soil organic carbon map of Coimbatore district can be used for framing land used policies, implementing site specific soil management options. This study can be extended to other districts of Tamil Nadu for proper soil fertility management.