Soil Organic Cabon Contents Estimation using Neural Network System

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Dynamics of organic matter in soil greatly affects the material circulation of the outermost layer of the earth and since it has the largest storage capacity in the terrestrial area, its accumulation and disappearance attracts high attention on global warming. Previous studies showed some achievements on the estimation of soil organic matter. However, since natural process is very complicated, the parameters are extracted from the accumulation of individual research, and are not estimated while considering mutual relationships based on a sufficient amount of data. Therefore, it is going to be waste of time or not realistic to tackle the problem for relating huge sets of soil parameters without understanding functional relationship. With the development of computers in recent years, machine learning and neural networks, which are rapidly becoming to be applied to realistic tasks, read huge amounts of data and learn individual relationships while estimating the target value.

Therefore, in this study, we tried to find deeply related soil parameters using 11000 sets of 16 parameters (limited only in Europe) obtained from Harmonized World Soil Database (FAO, IIASA). Recursive Feature Elimination (RFE method) eliminated the weakly related parameters, and then the deeply related parameters are used to estimate organic carbon using neural network. Among the verifications, the neural network showed the best performance when the parameter selection was set to seven. Clay content, dry bulk density, clay CEC, total CEC, base saturation, exchangeable base, and ESP are evaluated as having high relevance. Interestingly, uncommon parameters were also included in the selection. 70% of the models constructed with these seven parameters estimated the amount of soil organic matter very well, 30% resulted in extremely bad results. In addition, although the selected parameter is deeply related to soil organic matter contents, it is not clear whether each parameter works positive or negative for estimation in the non-linear function. Since the derived relation is nonlinear and very complicated, it is difficult to understand the calculation process. But since the model function is obtained without giving a functional system from the human side, it is going to be a powerful tool in extracting necessary parameters from huge data sets which seems to have unknown relationships. In addition, the research will be more effective, and will greatly contribute to elucidation of environmental dynamics involving complex factors.

Keywords: Soil Organic Carbon, Neural Network, Global Warming

