Review of: "Spatial Analysis of Soil Fertility Using Geostatistical Techniques And Artificial Neural Networks"

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Potential competing interests: No potential competing interests to declare.

This study conducted in the "Agronomy" production field of the National University of the Central Plains in Venezuela integrates geostatistical techniques and artificial neural networks to assess soil fertility spatially. Seventy soil samples were analyzed for ten variables, and geostatistical analysis, particularly ordinary kriging, was applied to produce individual soil property maps. The Fuzzy Kohonen Clustering Network (FKCN) algorithm was used to generate five soil fertility classes, and the resulting integrated map demonstrated an 86% reliability. The research offers valuable insights into site-specific soil management in precision agriculture. Nevertheless, there are various concerns that require addressing.

-The abstract is informative, but some sentences could be more concise. For instance, the first sentence can be rephrased for clarity: "This study employs geostatistical techniques and artificial neural networks to assess soil fertility spatially, offering valuable insights for precision agriculture."

-The introduction is thorough but could benefit from a more concise overview of the key objectives and a clearer transition to the methods section.

-While the methods section is generally well-described, consider providing more details on the specific steps taken in the geostatistical analysis and how the FKCN algorithm parameters were selected. This would enhance the reproducibility of your study.

- The discussion on the results is somewhat brief. Consider expanding on the implications of your findings and how they align with or differ from existing literature. Highlight any unexpected results and provide potential explanations.

- Explicitly address limitations in your study, such as assumptions made during geostatistical analysis, potential biases in the sampling, and any constraints in the FKCN algorithm. Acknowledging these limitations adds transparency to your work.

- The conclusion could be strengthened by summarizing key findings and emphasizing their significance. Additionally, provide clear directions for future research in the field.

- The inherent spatial variability in soil properties can pose a challenge. If the study area exhibits high spatial heterogeneity, it may be difficult to capture the true representativeness of soil fertility classes, leading to uncertainties in the interpretation of results.

- The scale at which soil samples are collected and analyzed may impact the interpretation of results. Different spatial scales can reveal different patterns, and the choice of scale should align with the objectives of the study and the intended applications of the results.

-The reliability of the results heavily depends on the quality and quantity of the input data. Incomplete or insufficient data may lead to biased interpretations. Issues such as data gaps, outliers, or errors in sampling can affect the accuracy of soil property maps and, consequently, the derived fertility classes.

- Geostatistical interpolation techniques, like ordinary kriging, rely on the assumption of spatial continuity. However, the accuracy of predictions may vary across the study area, and uncertainties associated with the interpolation process should be considered during interpretation.

-The performance of artificial neural network algorithms, such as the Fuzzy Kohonen Clustering Network (FKCN), can be sensitive to the selection of parameters. The interpretation of results should take into account the sensitivity of the chosen algorithm and the potential impact of parameter choices on the final soil fertility classes.

-The presence of spatial autocorrelation, where nearby locations are more similar than distant ones, may affect the reliability of the results. Spatial autocorrelation violates the assumption of independence in traditional statistical analyses, and it should be considered in the interpretation of spatial patterns.

- The assessment of the predictive ability of the models through cross-validation provides valuable insights, but challenges may arise in ensuring the representativeness of the validation dataset. Biases in the validation dataset could affect the accuracy of reliability estimates.

-External factors, such as climate, land use, and topography, can influence soil fertility. Failure to account for these environmental factors may result in incomplete interpretations of spatial patterns in soil fertility.