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Predicting Carbon Dynamics in Integrated Production Systems in Brazil using the CQESTR Model

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Introduction: Soil can be a source or sink of atmospheric CO_2 depending on the agriculture management practiced. Process-based C models are research tools to predict management impact on soil organic carbon (SOC) and options to increase SOC stocks and reduce atmospheric CO_2. The CQESTR model was used to examine the effect of different soil management practices, including integrated crop-livestock system (iCLS), and various scenarios on soil C dynamics over time and to validate its use for tropical ecosystems.

Material and Methods: The study was conducted at Embrapa Rice and Beans Research Center, in a tropical savannah ecosystem (climate Aw, 16°28" S, 49°17" W; 803 m asl.). The land was under native vegetation until 1950s and has been in iCLS since 2000. Crop rotations included corn (*Zea mays* L.) as summer crop and 3.5 or 4.5 years in pasture (*Urochloa sp.*) in Paddock 4 (P4), and 2.5 years crop phase [soybean (*Glycine max* L.), dryland rice (*Oryza sativa* L.) and corn] followed by 2.5 or 3.5 years in pasture (*Urochloa sp.*) in Paddock 5 (P5). Soil bulk density and organic matter were determined for the 0-10 and 10-30 cm depths in 1999, 2007, 2010, 2013 and 2014. The CQESTR model was calibrated with P5 data and validated with P4 data. Model performance was evaluated as described by (Liang et al., 2009) using regression analysis and mean square deviation (MSD) statistics.

Results and Conclusions: The CQESTR model was calibrated for Cerrado by adjusting the basic decomposition rate coefficient, *k*, from 0.0004 to 0.0003 which improved the accuracy of the simulated SOC values for these soils. The measured and simulated values for relatively small number of observed data were significantly ($P = 0.001$) correlated (r = 95.5%) with an MSD of 2.11 indicating that the model captured spatial-temporal dynamics of SOC in the topsoil (0-10 cm) for the iCLS very well despite limited SOC data. However, CQESTR did not predict SOC accumulation trend for the 10-30 cm layer. This underestimation could be due to lack of site specific grass or crop root biomass and root distribution under tropical conditions. Additional data are required to develop suitable coefficients and parameters to calibrate the model to improve the CQESTR prediction of SOC stabilization process in the subsoil layers of tropical soils.

References cited:
Liang et al. (2009) Ecol. Modell. 220(4):568-581. doi: 10.1016/j.ecolmodel.2008.11.012.

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